Midyear Report

L AND GAS URNAL

STAR FEATURES on all models

- Franksair Air "Feather-in" Drum Clutch Controls
- Final Drive Friction Drum Clutch
- Larger Capacity Equalized Brakes
- Rugged Compactness with Less Weight
- Lower Price with Franks Famous Quality

NOW AVAILABLE—FRANKS QUALITY skid winches for rod and tubing pulling, swabbing, and coring.* A servicing unit in the drilling rig class . . . *at less cost* PLUS air controls, PLUS final drive friction clutch (all clutches diaphragm actuated) even on small unit models, PLUS considerably more braking surface. The simplest, easiest handled gear shift you ever operated, at operator's position; single handle works all gears. Master clutch throw-out. Push-down brake, with finger tip brake set on handle. Vernier type hand throttle for swabbing and bailing. Compact, rugged units, embodying all of the economies inherent in Franks products. Phone, wire, or write Franks for detailed information.

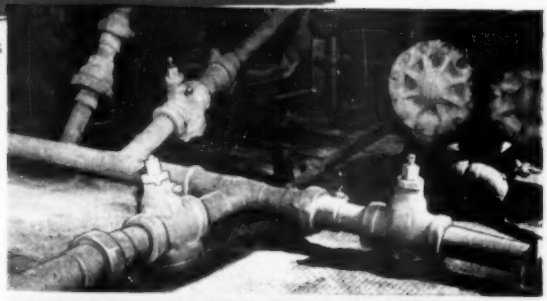
*Available with standard oil field engines. Rotary drive and spudding attachment optional.

5 MODELS, SINGLE OR DOUBLE DRUM, SHALLOW TO DEEP

FRANKS MFG. CORP.
Box 3218
TULSA, OKLAHOMA

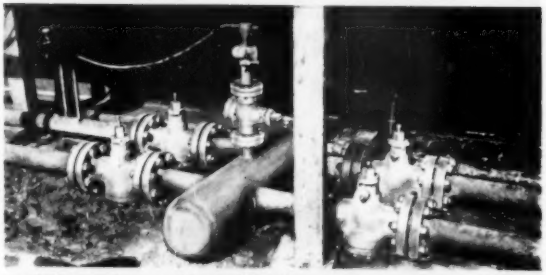
FRANKS MFG. CORP. TULSA, OKLAHOMA

Cut drilling costs by not cutting valve seats!



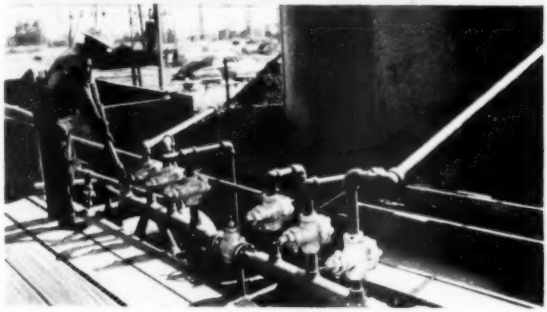
Nordstrom valves on engine end of mud pumps

● Grinding action of rotary drilling mud spells destruction on exposed valve seats. But no valve seat is exposed in a Nordstrom lubricated valve. The plug is constantly seated on a pressured film of lubricant. Each port is likewise sealed by lubricant grooves. Then for extra life the plug and body can be Merchrome coated with hard-facing which adds the most effective alloy for highest resistance against abrasion. So you get a combination without equal—lubricant protection, positive pressure seal, unexposed seat and greatly multiplied life. Your valve costs take a big drop when you install Nordstroms. Countless drilling records prove Nordstrom economy.



Nordstrom valves on mudlines and stand-by

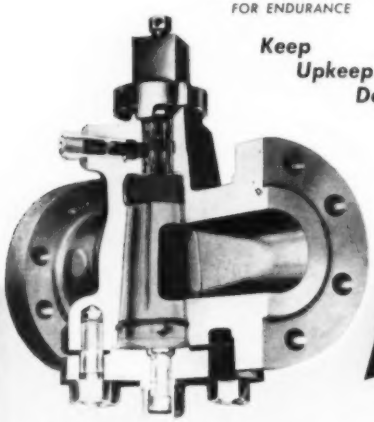
Nordstrom valves on mud tank lines



DRILL WITH MUD LINE VALVES

MERCHROME COATED—FOR ENDURANCE

Keep Upkeep Down



Use only genuine Nordcoseal lubricants—it pays!

Nordstrom LUBRICATED VALVES

NORDSTROM VALVE DIVISION

Rockwell Manufacturing Co.

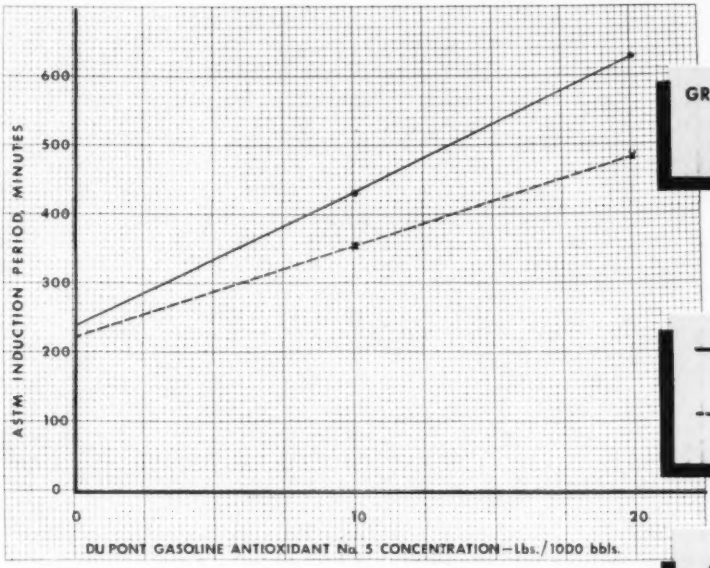
400 N. Lexington Ave., Pittsburgh 8, Pa. District offices in principal cities

Export—Rockwell International Corp., Empire State Bldg., New York 1

How one refiner*

Cut Gasoline Antioxidant Treating Costs 32%

with Du Pont Metal Deactivator



GRAPH SHOWING ANTIOXIDANT and METAL DEACTIVATOR RESPONSE

●——● Du Pont Gasoline Antioxidant No. 5 plus .25 lbs. per 1000 bbls. Du Pont Metal Deactivator

x--------x Du Pont Gasoline Antioxidant No. 5

This large refiner had been experiencing excessive gum formation in storage tanks. Ordinary analytical methods failed to show the presence of copper, but induction period tests demonstrated that copper was actually present in concentrations of less than 0.2 parts per million.

The use of Du Pont Metal Deactivator eliminated further trouble. The accompanying graph shows how with a Metal Deactivator concentration of only .25 lbs./1000 bbls. of gasoline it was possible to obtain a 400 minute induction period using 8.3 lbs. of antioxidant/1000 bbls. instead of 13.5 lbs./1000 bbls. without the use of Metal Deactivator—a total saving in treating costs of 32%.

Where copper is present, use Du Pont Metal Deactivator, the additive used by many refiners for years to economically control copper activity. For further information ask your Petroleum Chemicals representative or write the nearest District Office.

**Actual case taken from our files*

Antioxidant requirements for 1000 barrels of gasoline to meet 400 minute induction period

Du Pont Gasoline Antioxidant No. 5	13.5 lbs.
Du Pont Gasoline Antioxidant No. 5 plus 0.25 lbs. of Metal Deactivator per 1000 bbls.	8.3 lbs.
Net saving in cost through use of Du Pont Metal Deactivator	32%

DU PONT

PETROLEUM CHEMICALS

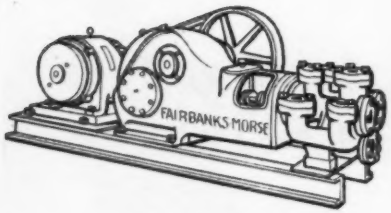
DU PONT

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

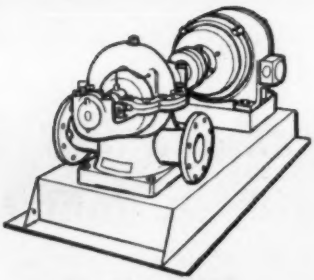
E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: Wilmington, Del.; Chicago, Ill.; Tulsa, Okla.; Houston, Texas; Los Angeles, Calif.

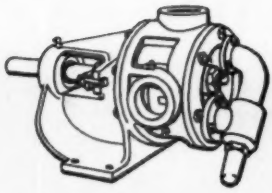
District Laboratories: Wilmington, Del.; Chicago, Ill.; Tulsa, Okla.; Houston, Texas; El Monte, Calif.



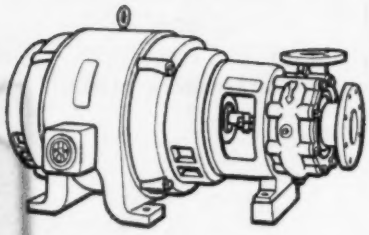
Power Pumps



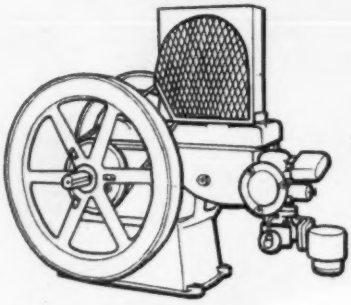
Centrifugal Pumps



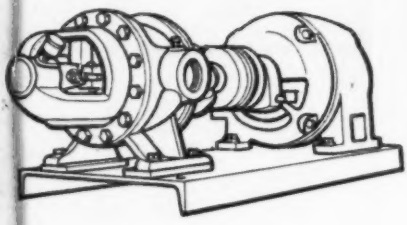
Rotary Pumps



Builtogether Pumps

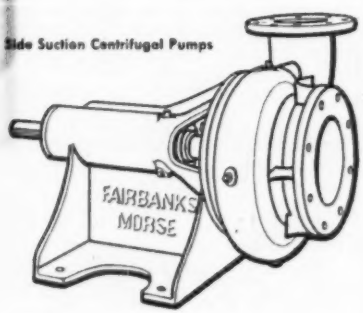


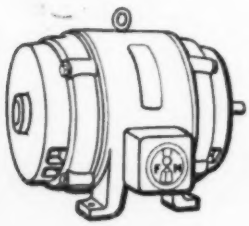
ZC Engines



Westco Pumps

Side Suction Centrifugal Pumps





Electric Motors

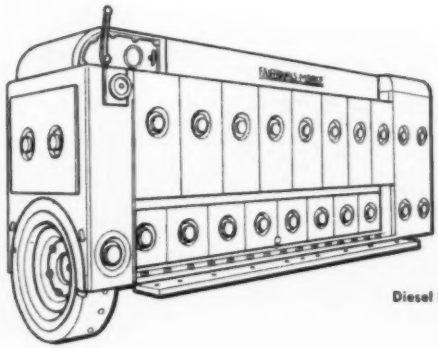
Designed for Dependability

Fairbanks-Morse Oil Field Equipment

FAIRBANKS-MORSE

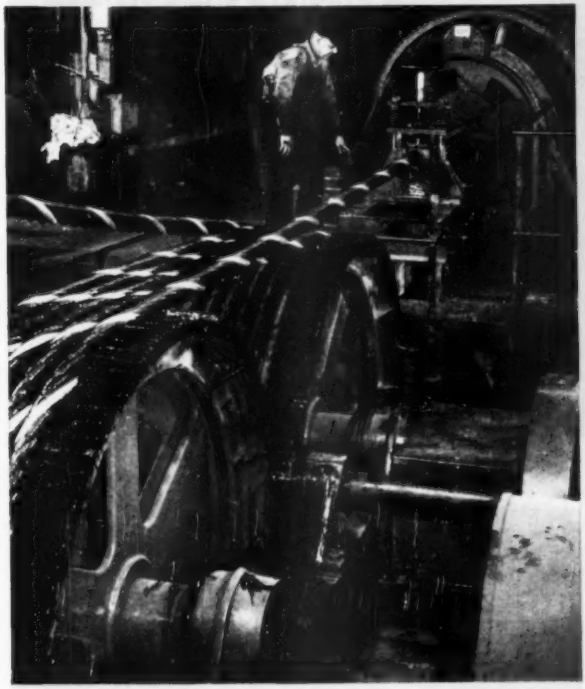
A name worth remembering

OIL FIELD EQUIPMENT • DIESEL LOCOMOTIVES • DIESEL ENGINES • PUMPS • SCALES • MOTORS • GENERATORS • STOKERS • RAILROAD MOTOR CARS and STANDPIPES • FARM EQUIPMENT • MAGNETOS

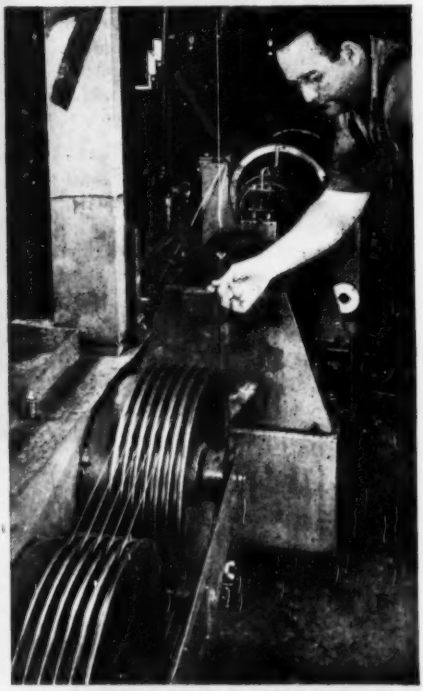


Diesel Engines

This photograph shows a 3⅛" diameter Monarch Whyte Strand Wire Rope coming off a Macwhyte closing machine. Weight of this rope is approximately 16.65 pounds per foot. It has a strength of approximately 392 tons and is used for the digging line on large dragline excavator with 35 cu. yd. bucket.



In this photograph is a 3/64" diameter Stainless Steel Cord coming off a Macwhyte closing machine. It weighs approximately 0.35 lbs. per 100 feet; has a strength of approximately 270 pounds, and is used for many small cord needs.



Whether you need

LARGE WIRE ROPE or SMALL WIRE CORD

make your selection from

You will get smoother operation and better service when you use the wire rope designed and manufactured to meet your requirements.

Macwhyte engineers are always glad to suggest the correct Macwhyte rope or cord best suited to your needs.

Just drop a card or letter to Macwhyte Company or your Macwhyte distributor.

a thousand and one
WIRE ROPES
made by
MACWHYTE

MACWHYTE COMPANY

2916 Fourteenth Avenue **Kenosha, Wisconsin**

Manufacturers of Monarch Whyte Strand PREformed, Internally Lubricated Wire Rope, Atlas Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal and Stainless Steel Wire Rope.

Mill Depots: New York • Pittsburgh • Chicago
Minneapolis • Fort Worth • Portland • Seattle
San Francisco • Los Angeles

Catalog on request.

AVAILABLE NOW!

AMERICAN IRON TUBING TOOL JOINTS

● American Iron Tubing Tool Joints are designed for use on tubing when it is used for completion, workover and deepening. In these joints the outside diameter and inside diameter of the tubing tool joint is the same as the outside diameter of the tubing coupling and the inside diameter of the tubing (as shown at right).

The use of tubing tool joints eliminates wear and abuse on the tubing and tubing coupling threads due to making and breaking of stands at the point where the tubing tool joints are installed on the string.

When the tubing is run to produce the well, the tubing tool joints are removed and the user is assured of pressure tight connections, since all thread wear has been on the tubing tool joint connections.

In the manufacture of American Iron Tubing Tool Joints the most accurate heat-treating methods known are provided by our new controlled-atmosphere furnace, shown below. A section of our fully equipped tool joint plant is also shown below.

AMERICAN IRON & MACHINE WORKS CO.
Oklahoma City, Oklahoma – Box 1177
Phone L. D. 518 – District Office, Houston, Texas – Export Office: 11 West 42nd St., New York City, N. Y.

Manufactured to the same rigid specifications and same analysis steel as the American Iron

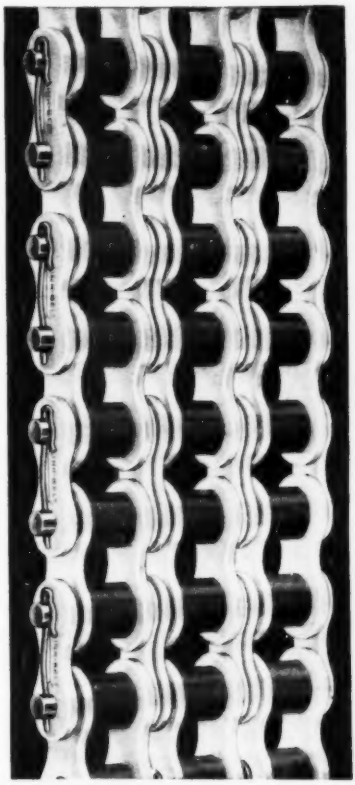
Straight Grip and AMWELD

AMERICAN IRON & MACHINE WORKS CO. · A · OKLAHOMA CITY U.S.A.

The heavier your load— the greater your need for...

LINK-BELT

Precision Steel ROLLER CHAIN



It's a long way down to the "business end" of holes these days . . . often between three and four miles. That makes a round trip of close to six to eight miles. With drill pipe loads approaching 200 tons, the call is for better and more powerful drives. Link-Belt Precision Steel Roller Chain is the answer.

So well has this strong, flexible, precision finished all-steel chain performed—under the toughest drilling conditions throughout the world —it's popularity has leaped ahead among the men who build, the men who buy, and the men who operate drilling rigs.

Link-Belt Precision Steel Roller Chain is built to manufacturers' (A.S.A.) specifications in standard sizes, in single and multiple widths. Meeting all drilling requirements, Link-Belt chain is available at your supply store.

> E-Z-ASSEMBLY <

Link-Belt engineers have developed a construction that makes assembly and disassembly of multiple-width chains in the field *much easier*. With this feature, load distribution across the width of the chain is maintained.

LINK-BELT COMPANY

Indianapolis 6, Dallas 1, Houston 3, Los Angeles 33, Kansas City 6, Mo., New York 7, Toronto 8. Distributors in all fields. 11-71

LINK BELT

Precision Steel

ROLLER CHAIN

The Oil and Gas Journal, published Thursdays by The Petroleum Publishing Company. Entered as second-class matter at post office at Tulsa, Okla., under act of March 3, 1879. U. S. and foreign rates to the petroleum industry, $3 yearly. Copyright 1949.

OHIO FUEL GAS CO. Hundreds of OIC Valves are installed at the Ohio Fuel Gas Company's 70-tank Mt. Sterling Compressor Station, about 20 miles southwest of Columbus, Ohio.

FOR PROPANE GAS SERVICE . . .

PUBLIC utilities which supply propane gas to supplement natural gas at times of peak demand, as well as the companies which rely on propane gas to save valuable production time, praise the stop watch accuracy of OIC Valves. Suppliers or users — they're finding that OIC Valves give steady, economical service on *all* propane gas installations.

One of the many utilities in this vitally important field is the Ohio Fuel Gas Company, serving almost half a million customers in a geographical area approximately half the size of Ohio. OIC Valves are installed at both of the company's propane gas plants, with a combined daily capacity equivalent to 65 million cubic feet of natural gas. These plants with 110 tanks (each 30,000 gallons water capacity), are at the company's 70-tank Mt. Sterling Station and the company's 40-tank McMahon Compressor Station near Toledo, Ohio.

OR ANY SERVICE!

If you don't have OIC's pace-setting valves installed on your lines — *no matter what the service* — switch to OIC! You'll find the right valve with the right trim for your specific job, in OIC's complete, long line of valves. Discover for yourself such exclusive features as the patented gland and gland flange that makes repacking of the stuffing box easy . . . seat rings of the modern end seated type for smooth operation — positive seating and long life . . . the special condensation chamber that protects the packing in high-temperature service. Discover, like hundreds of other companies, that it pays to invest in the best in valves. That means OIC!

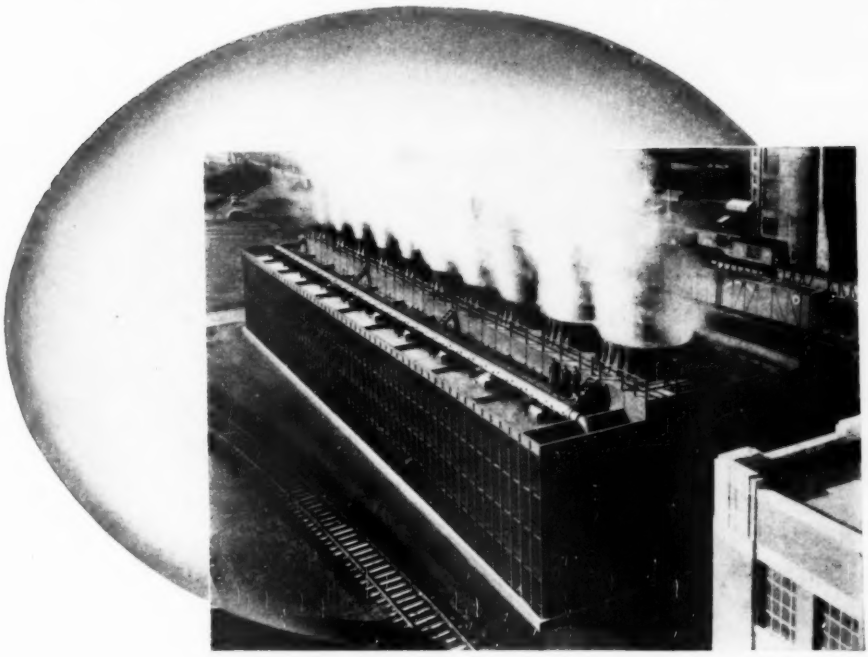
REPLACEMENT IS EASY WITH THE OIC VALVE CROSS REFERENCE CHART

Simply check the number of the valve on the line, and refer to this handy chart. It will tell you the correct OIC Valve needed to replace it. Write for your *free* copy to The Ohio Injector Company, Wadsworth, Ohio. 0-649-17

OIC VALVES

BRONZE • IRON • CAST STEEL • FORGED STEEL

Double-Flow = Double Efficiency



GIVES LOW COST WATER COOLING

Marley DOUBLE-FLOW Cooling Towers, using the practical, effective, CROSS-FLOW design (air across, water down) is the ultimate in Cooling Tower efficiency.

Only Double-Flow Cooling Towers offer outstanding, exclusive features such as:

1. **OPEN DISTRIBUTION SYSTEM** . . . On top of the tower, in plain view, easy to inspect, regulate and clean.
2. **NO DEAD AIR POCKETS** . . . Every drop of water meets a steady flow of air as it splashes down thru Marley's patented nail-less filling.
3. **BETTER MECHANICAL EQUIPMENT** . . . Equipped with Marley engineered and Marley made fans, fan cylinders, drive shafts and Geareducers . . . your assurance of top quality.
4. **SOUND STRUCTURES** . . . Double-Flows have withstood hurricanes, earthquakes and corrosive atmospheres because all lumber, hardware, supports, bracing and columns are designed to make an engineered structure.
5. **COMPLETELY SAFE OPERATION** . . . Stairways, handrails, walkways, and fan cylinders insure safe operation and maintenance in any kind of weather.
6. **MINIMUM DRAFT LOSS** . . . Drift eliminators set in slanting position allow greater area for air passage, minimizing draft loss and reducing horsepower requirements.
7. **GREATER COOLING CAPACITY** . . . Packed with decks of nail-less filling, Double-Flows have larger, wetted surface therefore greater cooling capacity.

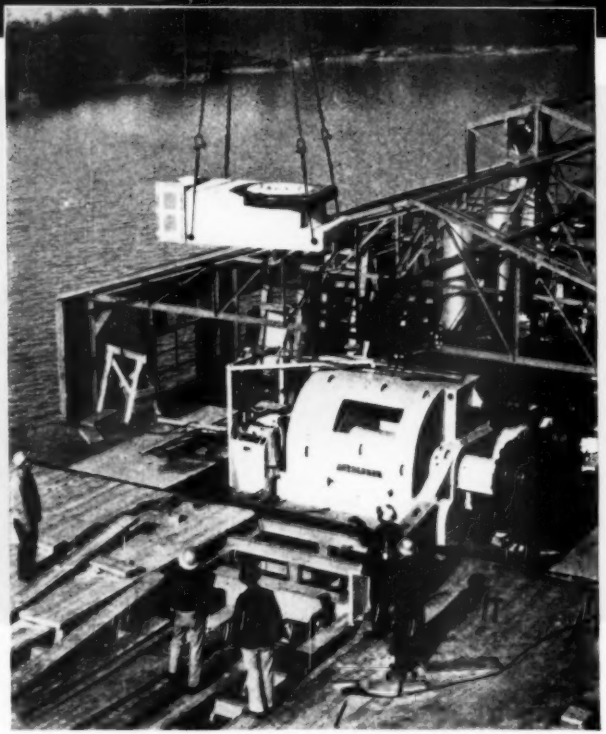
If you want to improve water cooling efficiency and reduce water cooling costs in your plant, it will pay you to ask a MARLEY "Double-Trained" Application Engineer to tell you all about the DOUBLE-EFFICIENCY of the MARLEY DOUBLE-FLOW. No cost or obligation.

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

So you're planning a drill barge!

Here's a suggestion: talk first with Bethlehem. For Bethlehem is equipped to do the WHOLE job—build the barge complete, build and install the drilling machinery, handle the piping, outfit everything.



An all-Bethlehem barge job under construction. This is a section of the main deck with the draw works in place; the rotary is being lowered into position. Below, out of sight, are the pumps.

The advantages of barge drilling in shallow inland waters are now so well recognized that they scarcely need detailing here. Whereas a platform outfit may be inoperative for weeks while equipment is being dismantled, moved, and rigged up, the self-contained barge plant can be moved as a unit and often be ready to resume in a matter of hours.

Equally well recognized are Bethlehem's facilities for producing "turnkey" barge jobs—jobs in which Bethlehem builds, supplies, and handles everything, down to the last detail. In our Gulf Coast yards Bethlehem shipbuilders engineer and fabricate the barge; from Bethlehem Supply come the specified items of rotary-drilling equipment, which are installed as the barge work progresses. Meanwhile, Bethlehem's purchasing division, with a deep background of experience, is buying the proper types of accessories and furnishings. When the job is delivered to the customer, it is *ready for work;* ready to be towed away at once to its first drilling assignment.

Think what this means! *One* responsibility—ours; we answer to you for everything. Gone are the worries and complications that are almost inevitable when you deal with a number of unrelated companies.

Your Bethlehem turnkey job will be as modern as today—up-to-the-minute from barge bottom to gin pole. It will serve you well for years to come. Our engineers will be glad to show you what we have done—and can do for *you*—in building and outfitting barges for marine drilling.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Shipbuilding Division

GULF COAST YARDS: BEAUMONT, TEXAS

BETHLEHEM SUPPLY COMPANY

GENERAL OFFICES: 21 E. SECOND ST., TULSA, OKLA.

Subsidiaries of Bethlehem Steel Corporation

AIRCO HARDFACING ALLOYS

add 2 to 25 times
LONGER SERVICE LIFE
to new and worn parts

SEVERE ABRASION

Pug mill knives, coke crusher rolls, mill guides and similar equipment, when hardfaced with Aircolite last many times longer, and at the same time give superior operating efficiency. For *extreme earth abrasion*, Airco Tungtube (tungsten carbide) is recommended.

IMPACT

Parts subjected to impact, like bucket lips, last longer when hardfaced with Airco Electric Self Hardening Alloy. Furthermore, parts can be rebuilt with this alloy at a fraction of new part cost. For *shattering impact*, Airco No. 388 is recommended.

HEAT and CORROSION

Aircoloy 1 and 6 effectively resist wear caused by heat and corrosion . . . for example, parts subject to intense heat, such as ingot tong bits, exhaust valves and seats, tap hole augers, and hot punches, last from 2 to 25 times longer when protected with these NEW Airco Hardfacing Alloys.

BUT TRY A FEW OF THESE NEW AIRCO HARDFACING ALLOYS YOURSELF . . . TAKE ADVANTAGE OF THE SPECIAL INTRODUCTORY LOW PRICE OFFER!

For Only $2.95 you receive a trial assortment of *Aircolite* (for oxy-acetylene and electric application) and Airco Electric Self Hardening Alloys, plus instruction sheets for each of these two alloys and a booklet describing the complete line of Airco Hardfacing Alloys.

Since this special price is good for a limited time only, we suggest that you fill in and mail the coupon below . . . NOW! Send it to our nearest office or authorized dealer. On West Coast: Air Reduction Pacific Company. Represented Internationally by Airco Corporation (International).

Mail this coupon today for your Special Assortment of the NEW AIRCO HARDFACING ALLOYS

EN
Air Reduction, 60 East 42nd Street, New York 17, N. Y.

☐ Here is my check for $2.95 — send me the special package of Airco's Hardfacing Alloys.

☐ Send me your booklet: "Airco Hardfacing Alloys" — at NO cost to me.

Firm_____

Signed By_____

Address_____

City & State_____

AIRCO AIR REDUCTION

Offices in All Principal Cities

Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Welding and Cutting Machines, Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

SELECT TESCO AS YOUR LOGICAL CASTING SOURCE *while your product is still on the drawing board!*

TESCO product engineers will consult on your product design to insure stronger, more economical castings.

As an added service to Gulf Coast manufacturers, TESCO recently established a product engineering department to work with manufacturers while their products are still in the design stage to insure the strongest, most economical casting designs.

These TESCO engineers are qualified by experience to make suggestions, for example, on your product designs that will *decrease weight without sacrificing strength*. They are qualified to show you how you can often save money and at the same time improve the appearance of your products with steel castings.

Let us show you case histories of how this added TESCO service has worked to the advantage of other Gulf Coast manufacturers. Invite the TESCO product engineer to look over your product designs and show you how you can benefit by *selecting TESCO as your logical casting source while your product is still on the drawing board.*

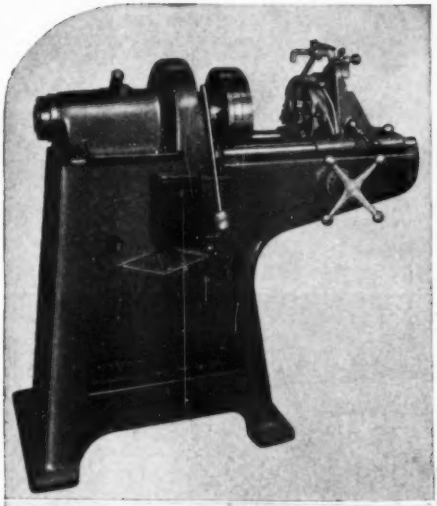
THESE SEVEN IMPORTANT FEATURES ARE YOURS ONLY IN STEEL CASTINGS

1. **UNIFORM STRUCTURE THROUGHOUT**—for greater strength.
2. **DISTRIBUTION OF METAL**—for better weight-strength ratio.
3. **CHOICE OF MECHANICAL PROPERTIES**—to fit your specific need.
4. **GOOD MACHINABILITY**—for better designs at lower cost.
5. **DIMENSIONAL STABILITY**—for better fit, better performance.
6. **EASE OF WELDING**—for fast assembly with other parts.
7. **FATIGUE RESISTANCE**—for longer life, less replacement.

TEXAS ELECTRIC STEEL CASTING CO.

GOOD CASTINGS — CARBON AND ALLOY STEEL — HOUSTON, TEXAS

For Quick Set-Up Changes



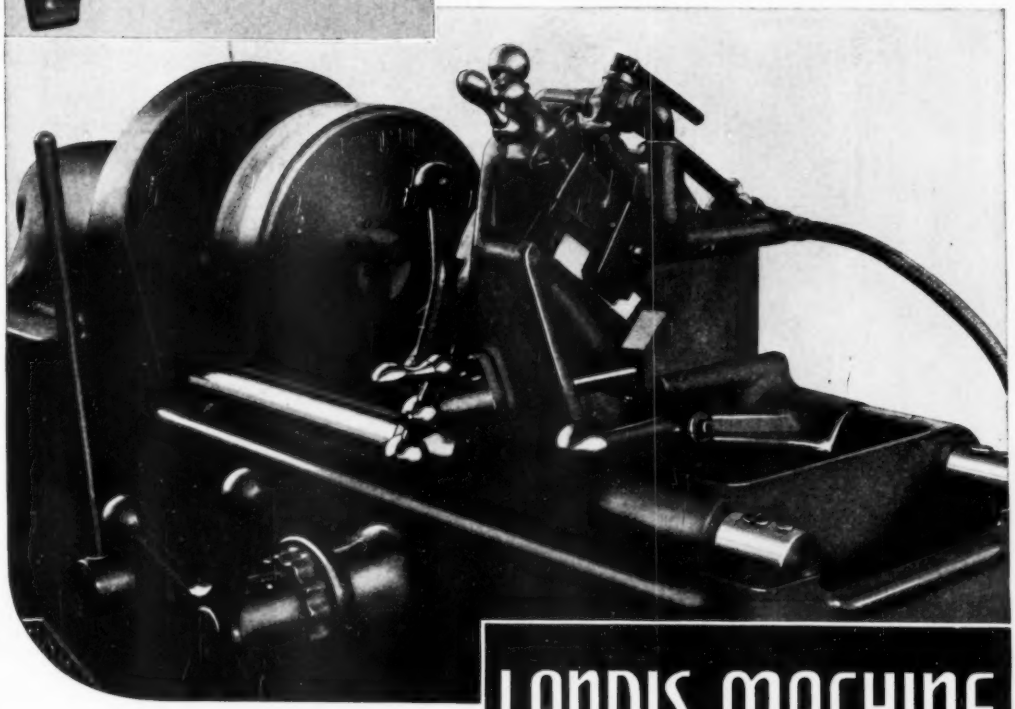
IN MAINTENANCE & JOBBING SHOPS

The ¾" and 2" Landis Stationary Die Heads, standard equipment with the LITTLE LANDIS, give rapid flexibility in cutting pipe threads within a range of ¼" to 2" and bolt threads ¼" to 1¼" or ⅜" to 1½".

The die heads are supported on the cross rail and locked securely in position by a latch. They are readily interchanged in a few seconds.

The Stationary Die Heads are quick-opening, with opening and closing controlled through a lever on the side of the head. Size adjustment is universal, made through a self-locking hand-wheel.

Write for Bulletin C-82



LANDIS
REG. U.S. PAT. OFF. TRADE MARK

LANDIS MACHINE Company
WAYNESBORO, PA., U.S.A.

Represented in the Domestic Oil Fields by: Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

• The new "Caterpillar" Engine factory—finest and most modern in the world.

New BIG

THE NEW 500-HP. D397
"CATERPILLAR" OILFIELD ENGINE

YELLOW ENGINES
built to handle big jobs

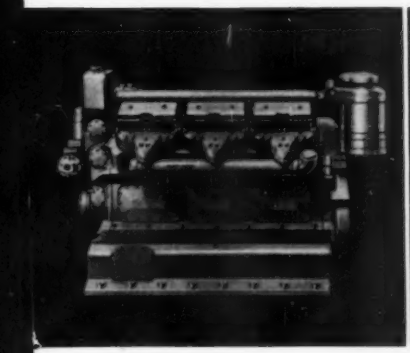
Oil men in every field have learned from long experience that they can always depend on "those big yellow 'Caterpillar' Engines." They've proved themselves on drawworks, rotaries, power slush pumps, pipeline pumps, well pumps, and a host of other oilfield jobs.

Now you can power your larger rigs with new, bigger "Cat" Engines and "Cat" Electric Sets. In addition to present models, are four great new "Caterpillar" Oilfield Engines, ranging up to 500 horsepower. With four D397 Engines compounded, you have up to 2000 horsepower for hoisting under maximum oil-drilling conditions.

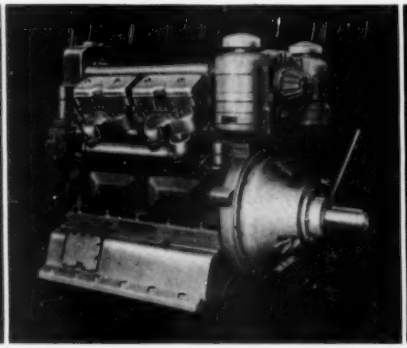
"Cat" Oilfield Engines are built in the world's finest, most modern engine factory. Every engine is built for utmost stamina and long life. Each is given a closely supervised dynamometer run to assure proper break-in and full horsepower output.

When you buy your new oilfield machinery, specify "Caterpillar" Oilfield Engines. Consult your reliable "Caterpillar" dealer about your oilfield power problems.

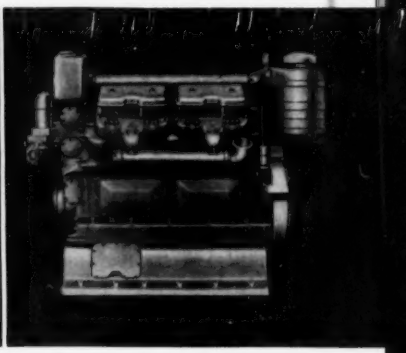
CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS



THE NEW 400-HP. D386
"CATERPILLAR" OILFIELD ENGINE



THE NEW 335-HP. D375
"CATERPILLAR" OILFIELD ENGINE



THE NEW 265-HP. D364
"CATERPILLAR" OILFIELD ENGINE

CATERPILLAR

REG. U. S. PAT. OFF.

OILFIELD ENGINES

TRACTORS MOTOR GRADERS

EARTHMOVING EQUIPMENT

CATERPILLAR TRACTOR CO.
Box OG-78, Peoria, Illinois
Send me specifications on the new "Cat" Oilfield Engines and Electric Sets.

Name _____

Address _____

"The lowest-cost gate valve we have ever used!"

. . . that's what they say about the

LUNKENHEIMER

"King Clip" Gate Valve

There are good reasons why so many valve users prefer "King-Clip" Valves. *Note these features:*

Exceptionally strong body and bonnet construction.
Extra length pipe threads for a strong, safe joint.
Sharply tapered disc seats tightly.
Large, unobstructed channels really drain the bonnet.
Coarse stuffing box threads provide greater resistance to corrosion and stripping . . . reduce annoyance of leaky stuffing boxes.
Easy to disassemble and reassemble.
Exceptionally low maintenance cost.
In bronze mounted patterns, rolled-in seat rings, integral non-corrodible stem thread bearing and special alloy stem assure longer life.

THE first clip type valve was originally developed many years ago by Lunkenheimer and was one of the most popular gate valves ever designed. As service demands became more severe, the basic design was improved into the present "King-Clip". Twenty-one different patterns are now available for a wide range of service conditions in virtually all industries.

The "King-Clip" is truly the leader of all clip type valves . . . it offers you a money saving solution to many valve problems. See your Lunkenheimer Distributor. He has a stock available to serve you promptly. Write for Circular No. 561.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

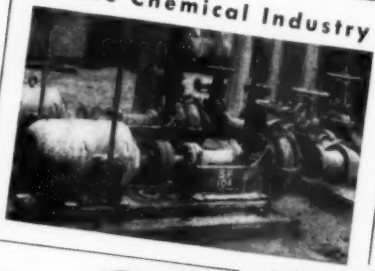
"QUALITY"

CINCINNATI 14, OHIO, U. S. A.

NEW YORK 13 CHICAGO 6 BOSTON 10 PHILADELPHIA 34

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

In the Chemical Industry



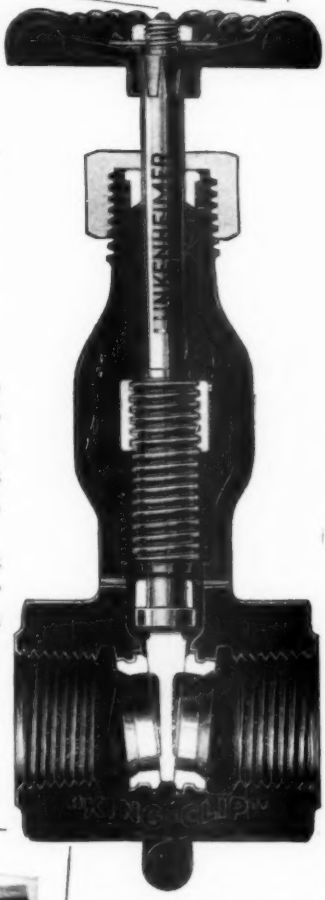
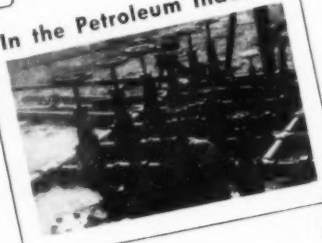


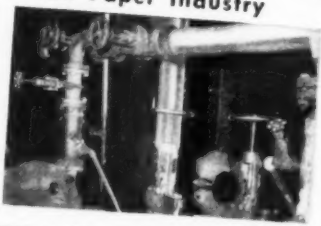
Fig. 1640 Iron Body Bronze Mounted . . . for steam, oil, gas, air, water & gasoline service.

Fig. 1644 All Iron . . . for handling solutions which attack bronze.

In the Petroleum Industry



In the Paper Industry



A-6 100 hp

HR-4 110 hp

H-6 150 hp

HR-6 165 hp

HS-6 200 hp

NH-6 200 hp

HRS-6 225 hp

L-6 250 hp

NHS-6 275 hp

NHRS-6 300 hp

NVH-12 400 hp

NVHS-12 550 hp

5 New CUMMINS DIESELS

1. **HR-400**—110 hp (max.), at 1800 rpm. 5⅛" bore, 6" stroke.
2. **HRS-600**—225 hp (max.), at 1800 rpm. 5⅛" bore, 6" stroke. Supercharged.
3. **NHRS-600**—300 hp (max.), at 2100 rpm. 5⅛" bore, 6" stroke. Supercharged.
4. **NVH-12**—400 hp (max.), at 2100 rpm. 5⅛" bore, 6" stroke.
5. **NVHS-12**—550 hp (max.), at 2100 rpm. 5⅛" bore, 6" stroke. Supercharged.

With the addition of 5 new engines, there's now a Cummins Diesel for any power job in the 50 (minimum) to 550 (maximum) hp range. Sixty-six individual models are available . . . with optional equipment to fit your specific operating requirements. Compounded units increase the Cummins range to 1440 hp.

The all-around economy of Cummins Diesels increases your profits on any automotive, marine or industrial job. Standardizing on Cummins Power gives you these additional advantages: engines, units and assemblies are interchangeable . . . service problems are simplified . . . replacement parts inventories are reduced . . . down-time is held to a minimum.

CUMMINS ENGINE COMPANY, INC. • COLUMBUS, INDIANA

Only 4 Men on His Payroll—

JAMES RAYMOND
Raymond's Service Station
Stamford, Conn.

BUT JAMES RAYMOND HAS OVER 1,000 SCIENTISTS AND TECHNICIANS WORKING FOR HIM— ASSURING HIM QUALITY PRODUCTS— BUILDING YOUR CONFIDENCE IN HIM!

COMPLETE research facilities are only a part of the *great Flying Red Horse team* that contributes to the success of James Raymond and 46,000 Mobilgas dealers and jobbers like him.

The *high quality* of the products *you* buy . . . the *low price* you pay . . . *the very things that create opportunity and build business* for these thousands of independent businessmen . . . are results of integrated operation like this:

. . . Socony-Vacuum scientists constantly prospecting for new oil reserves

. . . fast tankers transporting oil from *field* to *refinery* to *dealer* to *you*

. . . the efficient, co-ordinated hook-up of oil fields, pipelines, laboratories, refineries, and distribution facilities—*making shortcuts and savings* all down the line!

That's the kind of *competitive efficiency* that helps James Raymond to build his own successful business—that gives him the advantage of *bigness* right in his own home town.

★ ★ ★

That's the kind of teamwork that makes possible *a big money's-worth for you*—at a small profit per gallon for us!

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:
MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORP.

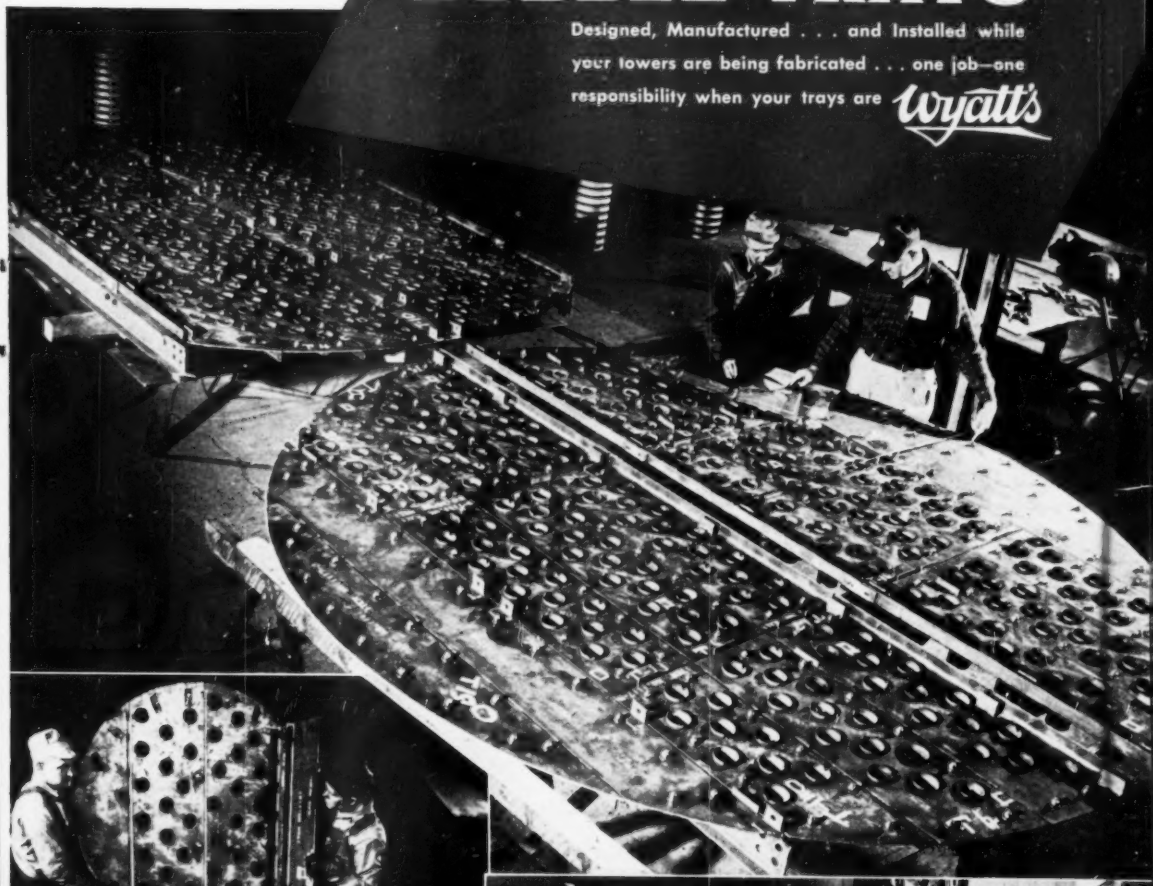
1,400 INDEPENDENT JOBBERS— 45,000 INDEPENDENT DEALERS—

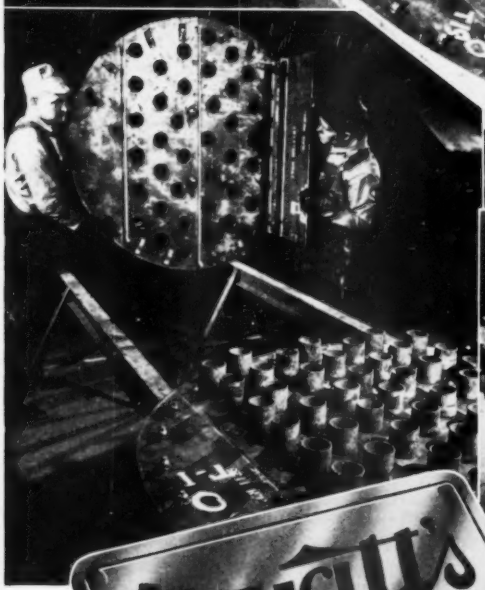
Rely on the Flying Red Horse for <u>What</u> <u>You</u> <u>Want!</u>

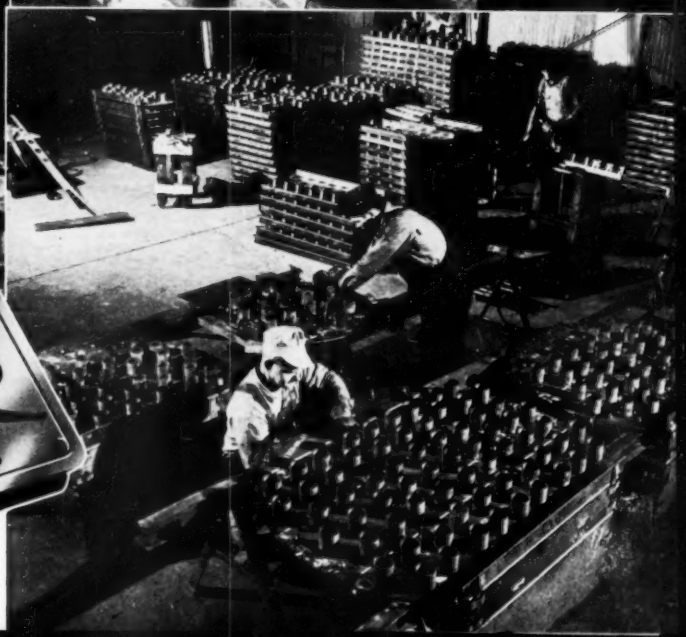
SOCONY-VACUUM

BUBBLE TRAYS

Designed, Manufactured . . . and Installed while your towers are being fabricated . . . one job—one responsibility when your trays are Wyatt's

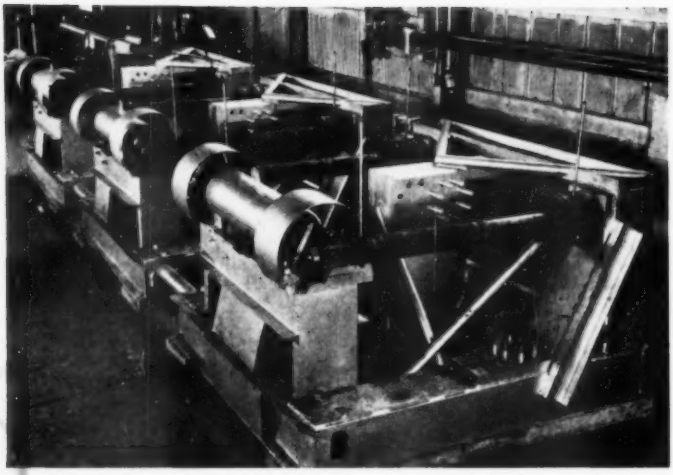






Wyatt's

HOUSTON - DALLAS



Strength through Design in Tube-Turn welding flanges

Taking the measure of piping fatigue

PIPE lines are *live, dynamic* members of a piping system. They *breathe* with changes in temperature and pressure. And the danger of fatigue failure from pressure shock, thermal shock, and cyclic conditions is ever-present.

More precise information was needed on this subject. So, Tube Turns research engineers set out to get the answers. For the purpose, they designed and built a unique cyclic testing machine to handle full-size piping assemblies under a wide range of temperature, pressure, and corrosive conditions. And on this torture rack they subjected flanged assemblies to reverse bending tests carried on to ultimate failure. Information revealed forms the basis of new designs for greater strength in Tube-Turn welding flanges.

Other piping assemblies, too—welding elbows, mitre bends, manufactured and fabricated tees, pipe bends—have been subjected to punishment more severe than any they would probably face in normal service.

And this perpetual search for greater strength through better design has paid off in the form of realistic, non-theoretical facts providing a sound basis for Tube Turns' manufacturing policies—facts important to anyone interested in getting his money's worth in long life from piping installations.

Tube Turns' research and development organization, finest in the welding fittings industry, is constantly striving for the improvement of present products, the development of new ones. Notable among their recent achievements have been the design of a new type welding tee and the development of aluminum welding flanges.

Ask to be put on the mailing list for Tube Turns' technical periodical, *Piping Engineering*. Paper 6.01, for instance, deals extensively with standard steel flanges. Others give you research findings and additional working information pertaining to piping not generally available in convenient form.

TUBE-TURN

tt

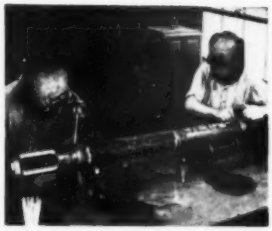
WELDING FITTINGS AND FLANGES

TUBE TURNS, INC.

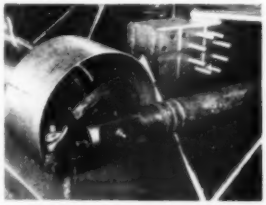
240 East Broadway, Dept. H, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

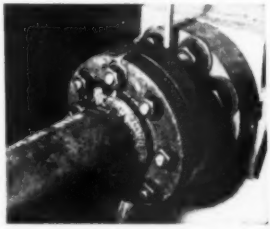
TYPICAL FLANGE ASSEMBLY TESTS



Assemblies were of 4-inch nominal size with 300 pound forged steel flanges and standard weight pipe.



Eccentric crank arm produces up-and-down movement which creates a cyclic bending moment on flange or fitting at oppo ite end of assembly.



Water spurts from crack in test specimen. Almost invariably, failure occurred in the pipe adjacent to the flange.

Aluminum welding flanges . . . another Tube Turns first! Available in a wide range of types and sizes.

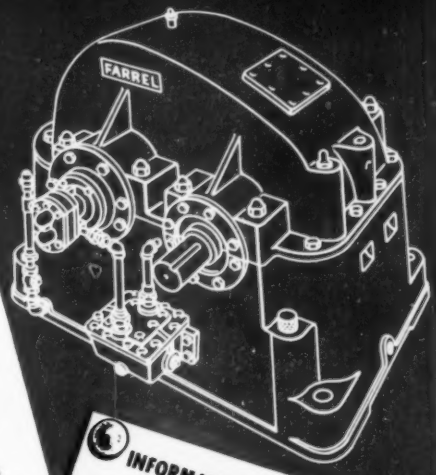
SPEED INCREASERS
drawn to your specifications

In 1932, Farrel developed a series of speed increasers designed specifically for pipe-line pumping service in the oil industry.

All of the units installed then and since are still in operation—conclusive proof that they were correctly designed for the job they had to do.

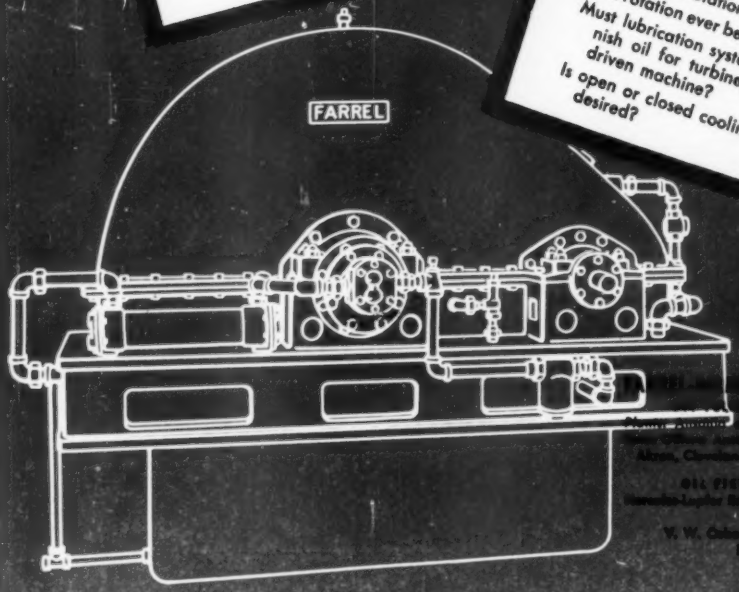
Today, the *modern* line of Farrel speed increasing units consists of 49 standard sizes with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

For full information about these *designed-for-the-job* speed increasers, write for a FREE copy of NEW Bulletin No. 448.



INFORMATION REQUIRED FOR QUOTING OR ORDERING

Kind of driver?
Kind of driven machine?
HP and RPM of driver?
HP and RPM of driven machine?
Hand of unit?
Are any shafts to be double extended?
Direction of rotation?
Will rotation ever be reversed?
Must lubrication system also furnish oil for turbine, motor or driven machine?
Is open or closed cooling system desired?



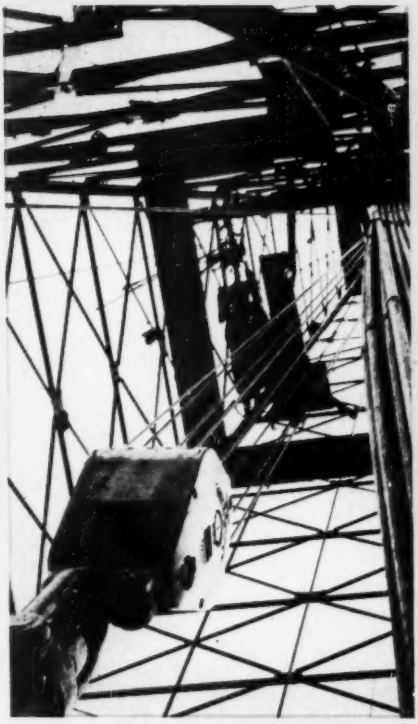
FARREL-BIRMINGHAM COMPANY, INC.
[illegible] ST., BUFFALO 7, N. Y.
[illegible] Derby, Ganes, Buffalo, N. Y.
[illegible], Buffalo, New York, Pittsburgh, Akron, Cleveland, Detroit, Chicago, Los Angeles.

OIL FIELD REPRESENTATIVES
Hercules-Supfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.
W. W. Osborne, 822-A M & M Building, Houston 2, Texas

Farrel-Birmingham

Here's one place to

reduce downtime



● You can eliminate many costly rig tie-ups by making certain that your wire line is always in first-class condition . . . ready for service every minute of every shift.

First, make sure that you get highest quality and finest workmanship in wire lines by specifying American Tiger Brand. Our catalog will help you select the correct size, construction and the most suitable grade of steel.

Second, give your wire lines the kind of care that adds thousands of ton-miles of service to every reel. For example, keep an accurate check on line wear so that you can shift the line at the proper time and thus distribute wear. Our booklet, "Valuable Facts about the Care and Use of Wire Rope," contains many other suggestions that will add appreciably to line life.

American Tiger Brand Wire Lines, given proper care, will help you get rid of many downtime headaches. Mail the coupon today.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

SEND FOR THIS LITERATURE

American Steel & Wire Company
Rockefeller Building, Dept. P-79
Cleveland 13, Ohio

Please send me:

☐ "American Tiger Brand Lines for the Oil Industry"
☐ "Valuable Facts about the Use and Care of Wire Rope"

Name .....

Company .....

Address .....

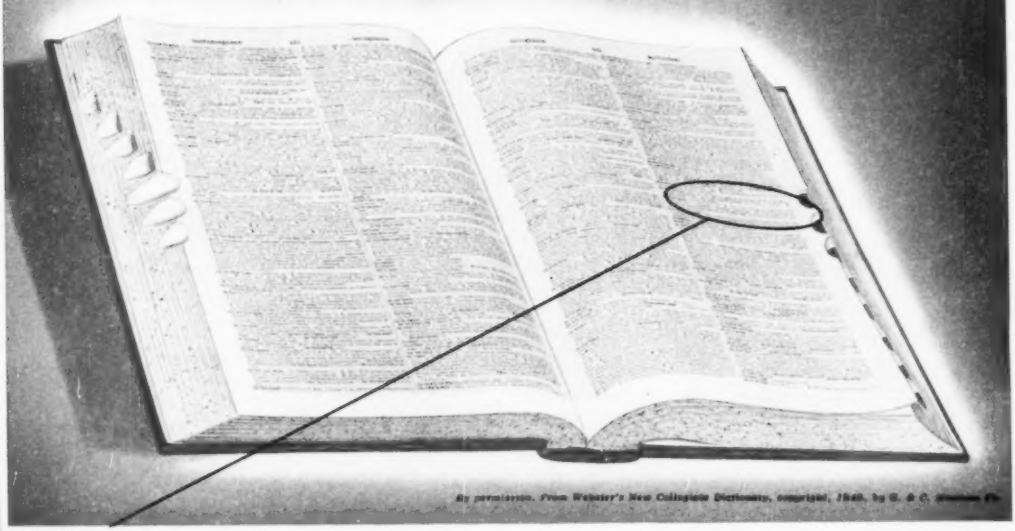
Position .....

AMERICAN TIGER BRAND WIRE ROPE

Excellay Preformed

UNITED STATES STEEL

Why We Say
CHEMICO PLANTS ARE PROFITABLE INVESTMENTS



Webster defines an investment as "the investing of money or capital for income or profit." In the heavy chemical field, Chemico is a proved translator of *investment* into profit. Here's why:

Every Chemico-built plant is planned and designed to fit individual needs.

Each plant is designed by engineers and technologists of recognized authority.

Chemico's advanced processes and selection of equipment insure high efficiency of operation...and, where necessary, new processes and facilities are developed to meet special circumstances.

Chemico brings to bear on each new project its 35 years of experience in constructing a wide range of heavy chemical installations.

Chemico turns the plant over to the purchaser only after over-all performance guarantees have been met. But initial performance is not enough. Chemico also trains the client's staff in every phase of operation.

Chemico takes full responsibility for the job... from initial investigation to completed project.

These are some of the reasons why owners have found that "*Chemico Plants are Profitable Investments.*"

Before deciding to build a new heavy chemical plant or remodel an old one, it will pay you to consult Chemico. CC 196

Typical Chemico Undertakings

PLANTS FOR PRODUCTION OF

SYNTHETIC AMMONIA
SYNTHETIC METHANOL
DOUBLE SUPERPHOSPHATE
AMMONIUM PHOSPHATE
AMMONIUM SULFATE
AMMONIUM NITRATE
CALCIUM NITRATE
FORMALIN

PLANTS FOR PRODUCTION, CONCENTRATION AND RECOVERY OF

HYDROCHLORIC ACID
NITRIC ACID
PHOSPHORIC ACID
SULFURIC ACID

CHEMICAL CONSTRUCTION CORPORATION

EMPIRE STATE BLDG., 350 FIFTH AVENUE, NEW YORK 1, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE
CYANAMID PRODUCTS, LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W. C. 2, ENGLAND

EUROPEAN LICENSEE OF N. E. C. PROCESS
HYDRO-NITRO S. A., 8 QUAI DU CHEVAL BLANC, GENEVA, SWITZERLAND

CABLES: CHEMICONST, NEW YORK

Chemico Plants are profitable investments

IF YOU'VE [illegible] HAD A WILD WELL ON YOUR HANDS

THEN YOU CAN BETTER EVALUATE THE MULTIPLE SAFETY FEATURES OF

CAMERON *Forged Steel* CASING HEADS

PRE-TESTED REPACKABLE PLASTIC SEAL, OR PRE-TESTED WELDED SEAL

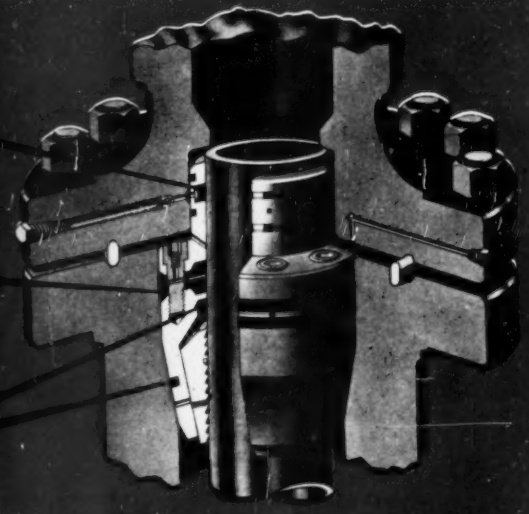
Cross-over effect combining with type "R" packoff, as illustrated, with plastic packing and pressure test ports in bottom flange of upper casing head.

PRE-TESTED RESILIENT SEAL

Main casing seal is effected by tightening screwed head cap against or compress Hytor seal ring. This seal is tested then one cap screw which is provided with pressure test port, as illustrated.

INSTANTANEOUS RESILIENT SEAL WHEN SETTING THRU PREVENTERS

Resilient seal rings of slip joint accommodate seal pressure after hanger is lowered thru preventers and seated in casing head, allowing safe removal of preventers.



Type "NTXM"

Now, regardless of well condition, there is a Cameron casing hanger available to exactly meet your requirements. Start your well with a Cameron Forged Steel Casing Head and then select one of the *twenty-two different interchangeable hangers* that your particular well condition may require.

While the Cameron Type "NTXM" Hanger illustrated above provides multiple repackable and pre-tested seals with slip suspension, practically every type of hanger developed to date, starting with the simplest "ball-weevil" type (see below) are also available. Complete details will gladly be sent on request.

CAMERON IRON WORKS, INC.

P. O. BOX 1212 • HOUSTON, TEXAS

Export: 74 Trinity Place, New York, N. Y.

OR PERHAPS ONE OF THESE SIMPLER, INTERCHANGEABLE HANGERS WILL FILL YOUR REQUIREMENTS

TYPE BX TYPE BO TYPE KT TYPE KBX TYPE BT TYPE BB

No Twist-No Stress-No Strain

with

Mack Six-Wheelers

• That's because only Mack six-wheelers have the advantage of Mack's famed Balanced Bogie. Here's an outstanding development that means unmatched flexibility . . . mastery of the toughest terrain without stress or strain.

The exceptional flexibility of the Mack Balanced Bogie insures equal traction, even tire loading and uniform braking on all four wheels. Exclusive Mack Power Divider assures traction at all times, regardless of terrain.

Simplicity and rugged strength are typified in the functional construction of the Balanced Bogie. Maintenance requirements are reduced to a minimum. Outside of the brake system only four points on the assembly require lubrication. No place in the suspension ever needs adjustment.

For detailed information on how this and other Mack features can cut costs and increase profits on your particular job, see your nearest Mack branch or dealer.

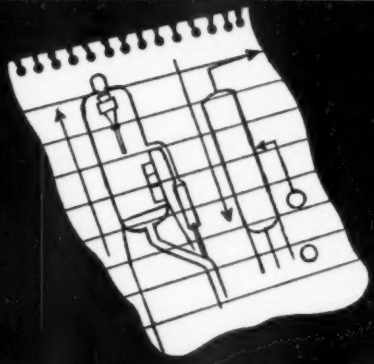
IT'S PART OF THE LANGUAGE

Built Like a

Mack

Truck

Mack Trucks, Inc., Empire State Bldg., New York 1, N. Y. Factories at Allentown, Pa.; Plainfield, N. J.; New Brunswick, N. J.; Long Island City, N. Y. Factory branches and dealers in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.



FULFILLMENT

Fulfillment of contractual guarantees in plant design and construction is to be expected of any well qualified organization. It becomes a basis for preference as engineering commitments are consistently surpassed. Lummus stands ready for evaluation on whatever scale of values means the most to you: output, completion dates, or long initial runs. But the test that Lummus regards as the best evidence of its ability to fulfill your needs is its record of success in bringing *new*-process plants from pilot stage to full-scale operation.

teamwork
economy
perspective
resourcefulness

LUMMUS designs and builds with **FULFILLMENT** technique

FULFILLMENT (plant capacity)

A catalytic cracking plant, designed for 5400 B/D, was boosted to 6000 B/D on the 85th day of its initial run. Guaranteed percentage yield of high octane gasoline was also exceeded: 3070 B/D of 10-lb. RVP gasoline against a 2040 B/D guarantee.

FULFILLMENT (initial run)

A long initial run accurately forecasts long-term performance almost every time. This 10,000 B/D catalytic cracking plant was first shut down (for inspection) after 240 days on stream. No major maintenance was necessary. Total turnaround time was some 10,000 manhours.

FULFILLMENT (continuous output)

A continuous processing record for this customer—over 1,200,000 barrels of crude—was established by this Lummus high-pressure cracking unit—on the line for 124 days.

FULFILLMENT (completion schedule)

A polyform gas reversion plant, designed to produce 4000 B/D of high octane gasoline, was completed on a tight 10-month schedule. The acceptance test run met all guarantees. The initial run continued 65 days before shutdown for employee-training purposes.

THE LUMMUS COMPANY
420 Lexington Avenue, New York 17, N. Y.

LUMMUS

CHICAGO—600 South Michigan Avenue, Chicago 5, Ill.
HOUSTON—Mellie Esperson Bldg., Houston 2, Texas

The Lummus Company, Ltd., 525 Oxford St., London, W-1, England

Société Française des Techniques Lummus
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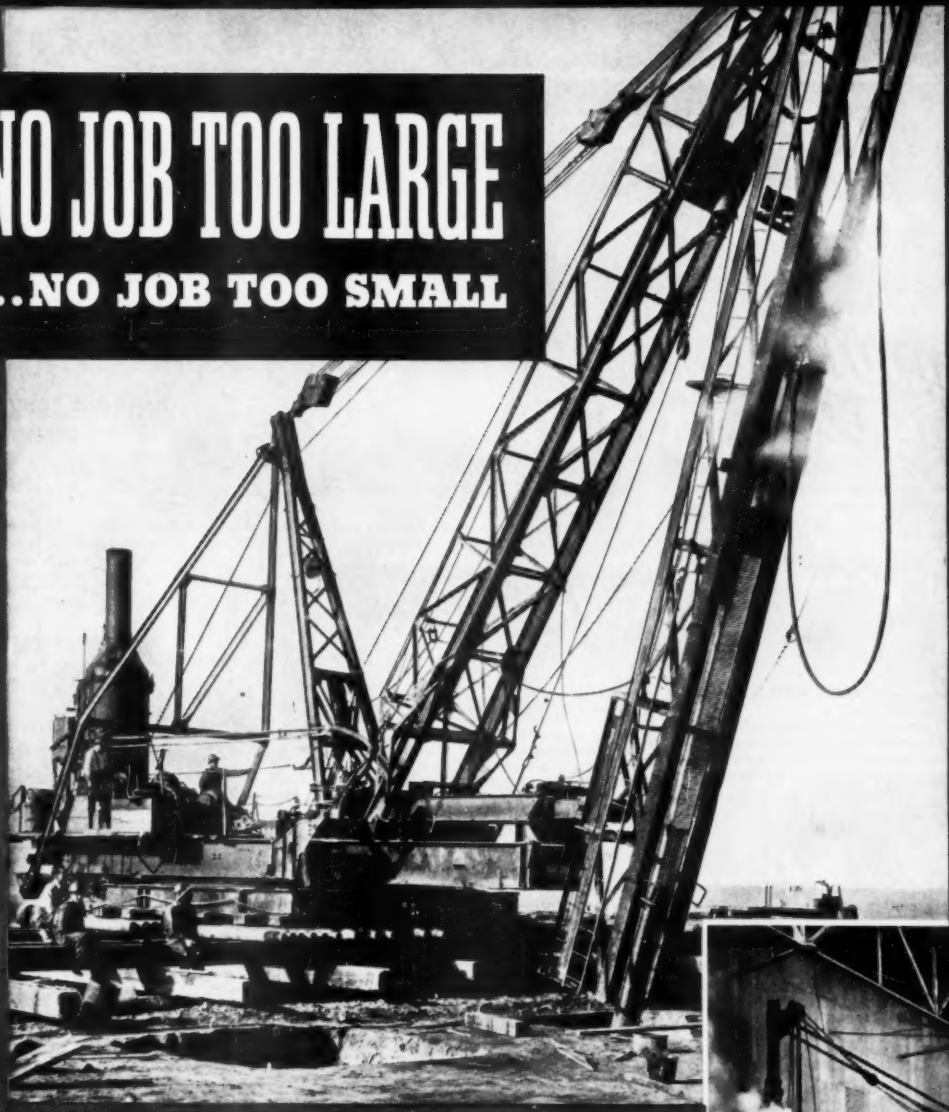
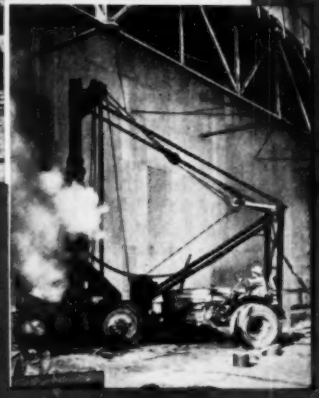
Esquina Las Gradillas, Caracas, Venezuela

NO JOB TOO LARGE

...NO JOB TOO SMALL





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From a job of a few piles to one requiring many thousand piles, from a single caisson to a skyscraper foundation, from a simple soil investigation to a complete port development—no job is too large or too small for the Raymond organization. Specialized equipment, broad experience and highly trained personnel are your assurance of dependable work at minimum cost. Your inquiry will receive prompt attention.

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SCOPE OF RAYMOND'S ACTIVITIES includes every recognized type of foundation construction—concrete, composite, precast, steel, pipe and wood piles. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements and borings for soil investigation.

10,000 HOURS WITH KOPPERS PISTON RINGS

MINUTES ARE DOLLARS

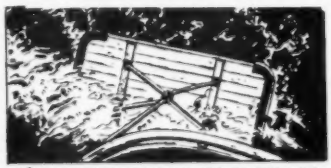
....ON THE FAMOUS FISHING "BANKS"

"THEY'VE REACHED THE "BANKS"! NOW THE HEAVY BUT INTRICATE WORK BEGINS. CREW MAKES FIRST "SET" AT DAWN WHILE A STIFF NOR' EASTER WHIPS UP THE SEA.

AS DRAGGING CONTINUES, CREW MEMBERS CLEAN AND ICE THE FISH. ON THE USUAL TRIP, 37 "SETS" ARE MADE....TOTAL TOWING OF CATCHES, THAT AVERAGE 4000 LBS. IS 227 MILES! WHAT A STRAIN ON ANY ENGINE!

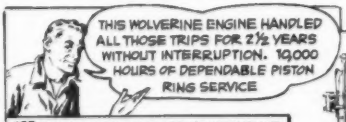
THE FISHING DRAGGER, "OLYMPIA LA ROSA" LEAVES FOR THE FISHING BANKS AGAIN, AFTER UNLOADING CATCH AT BOSTON WHARF.

ALL HANDS GET READY FOR THE FIRST "DRAG" AS THE "OLYMPIA LA ROSA" DRIVES STEADILY THROUGH THE OCEAN SWELLS.

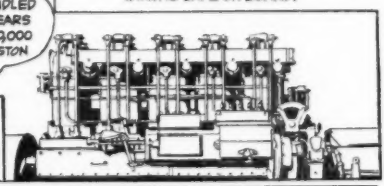


NET IS DRAGGED BY TWO CABLES, RUNNING FROM A FORWARD AND AFT GALLOWS FRAME. THE MOUTH OF THE NET IS HELD OPEN BY PARAVANES OR "BOARDS." HERE THE POWERFUL WOLVERINE DIESEL MUST NOT FAIL OR FALTER...OR THE VALUABLE CATCH WILL SPILL OUT.

THE SAME 195 H.P. WOLVERINE DIESEL POWERS THE DECK WINCHES. MINUTES ARE DOLLARS WHEN THE FISH ARE RUNNING —ANOTHER "SET" IS MADE AS SOON AS THE CATCH IS SAFE ON BOARD.


THIS WOLVERINE ENGINE HANDLED ALL THOSE TRIPS FOR 2½ YEARS WITHOUT INTERRUPTION. 10,000 HOURS OF DEPENDABLE PISTON RING SERVICE

WHAT A RECORD FOR GOOD MAINTENANCE AND KOPPERS PISTON RINGS WHICH POWER THE "OLYMPIA LA ROSA"! ENGINE STILL IN SERVICE, GIVING RATED POWER—WITH NO INCREASE IN OIL CONSUMPTION.



Two and one-half years and 10,000 hours of tough operation on the fishing banks . . . and still going strong. Engine still gives rated power and no increase in oil consumption!

That's typical of the records Koppers Piston Rings are setting in the tough jobs—on the sea, on the road and on the rails. The reason for these great records can be found in two great Koppers developments in piston rings . . . Porous Chrome* and K-Spun, the miracle metal for piston rings.

Koppers American Hammered Piston Rings are the choice of those who demand better Diesel Engine service at lower costs. Check with Koppers engineers for more details. It will pay you to do it now. Koppers Company, Inc., Piston Ring Dept., Box 626, Baltimore 3, Maryland.

*VAN DER HORST PROCESS

WHAT POROUS CHROME PLATING AND K-SPUN METAL MEAN TO YOU

1. Guaranteed against ring breakage. Tensile strength double ordinary gray iron castings.
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3. Ring and cylinder wear greatly reduced.
4. Fifty percent more elasticity—retains shape and tension far longer.
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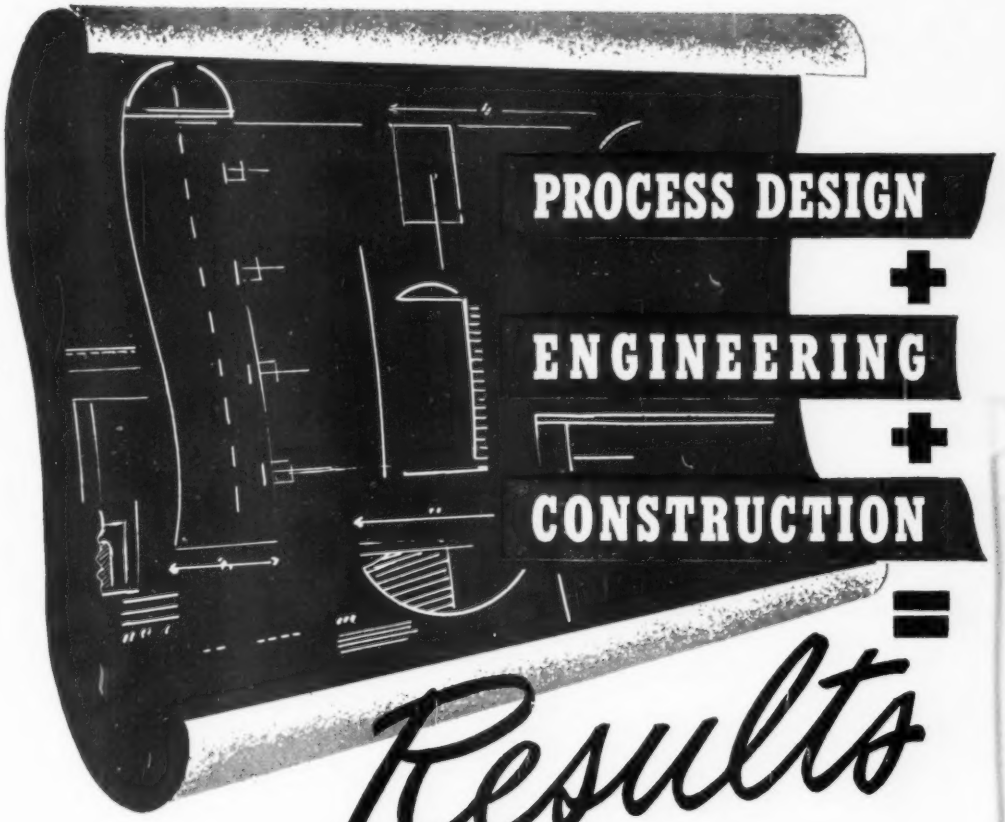
KOPPERS

American Hammered

KOPPERS PISTON RINGS



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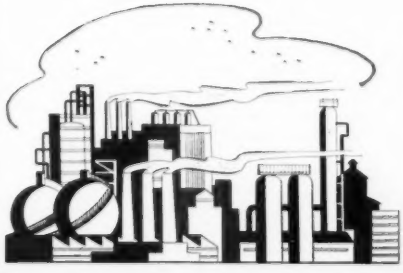

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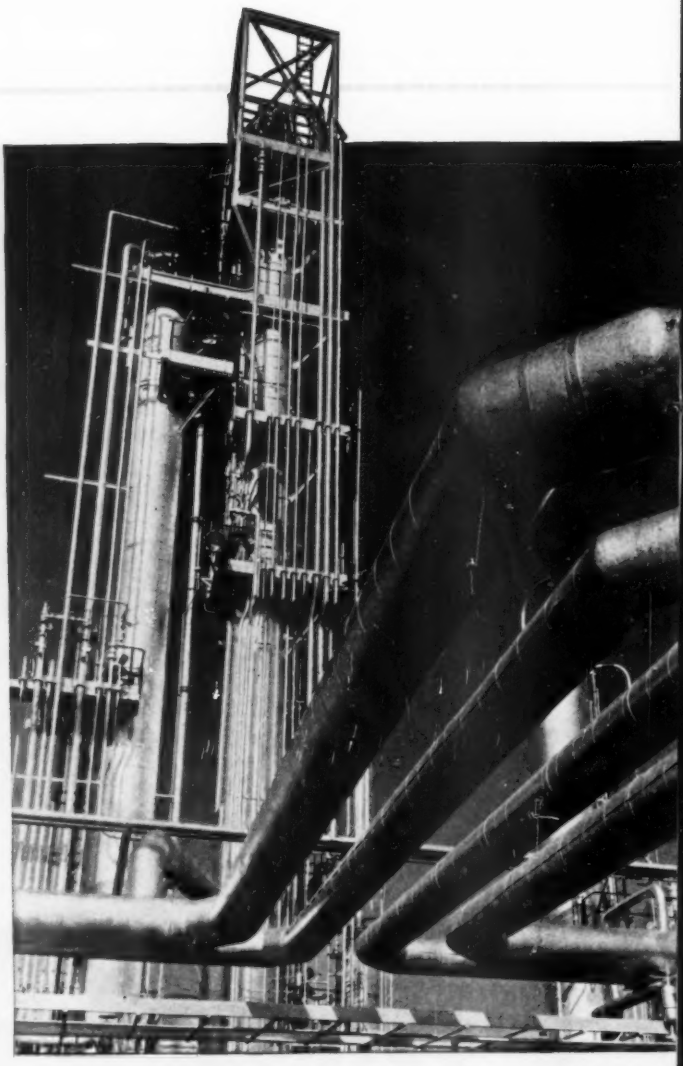
Westinghouse



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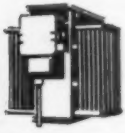

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Industrial Lighting

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Oil Immersed Pushbuttons

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WESTINGHOUSE

Westinghouse

EQUIPMENT FOR THE PETROLEUM INDUSTRY

Unit Responsibility

CUTS REFINERY POWER COSTS

The manufacturer of your power generating and distribution equipment can play a vital role in providing the most efficient power system for your refining and petrochemical processes. In serving you, that manufacturer should be capable of:

1. Providing the complete line of power equipment your process may require.
2. Furnishing you co-ordinated engineering and supervision of installation.
3. Giving you the benefit of years of experience in the application of power equipment in the Petroleum Industry.

These elements of unit responsibility add up to a reduction in costs. You get them all from Westinghouse.

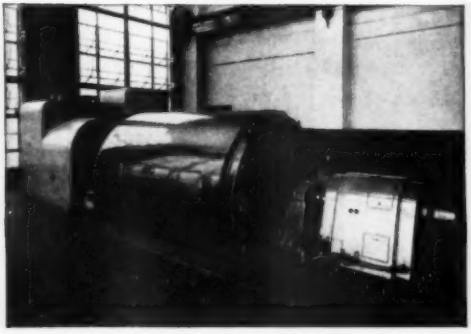
GENERATION: Westinghouse gives you the complete installation for producing power, plus help in working out your electrical and steam requirements for most efficient plant balance.

DISTRIBUTION: Westinghouse makes a correlated line of distribution apparatus, ranging from the smallest arrester to the world's largest substation. All indoor and outdoor enclosures are Bonderized to resist corrosion, and outdoor switchgear is additionally protected by all-weather undersurface coating.

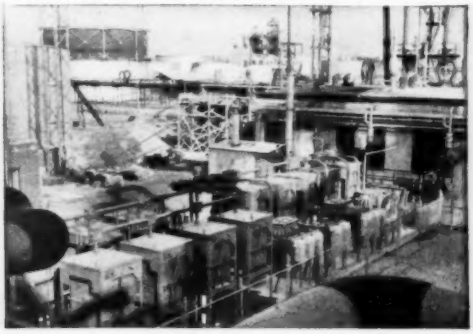
UTILIZATION: Westinghouse makes a full line of mechanical drive turbines and oil refinery motors, ranging from small, explosion-proof, fan-cooled, Life-Line motors to the largest explosion-resisting, inert-gas-filled, squirrel-cage type motors ever built. A complete line of Westinghouse controls, including corrosion-proof or explosion-proof types where needed, is also available to meet the rigid requirements of refinery service.

Give us an opportunity to assume this unit responsibility and help you find the solution to your refinery power problems. Call your nearest Westinghouse office, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-94803



This Westinghouse 7500-kva turbogenerator is installed in a large refinery power plant. Where utility power is not available in sufficient quantities for a large refinery, units of this type provide an economical source of power.



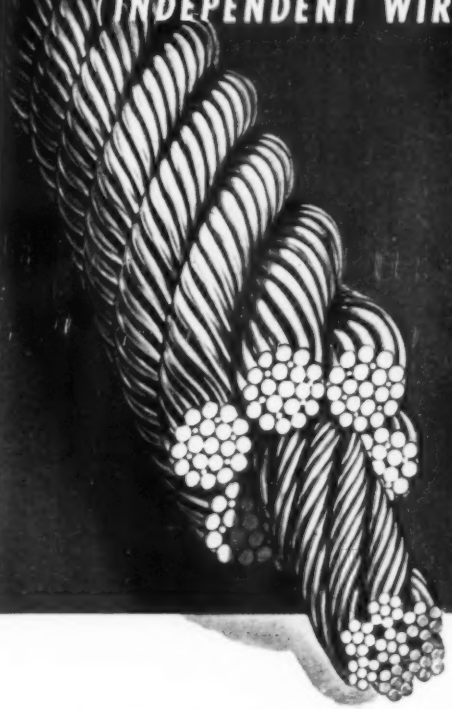
The use of Westinghouse oil-immersed equipment suitable for hazardous and corrosive atmospheres made it possible to locate this motor control and distribution center near the loads, thus reducing length of individual circuit runs.

JAR ROEBLING

WHEN TO SPECIFY

I.W.R.C.

(INDEPENDENT WIRE ROPE CORE)



Preformed "Blue Center" Wire Rope

PERFORMANCE-PROVEN WITH OIL MEN

IN THE TOUGH SPOTS, rope with an Independent Wire Rope Core gives best and longest service! I.W.R.C. is outstanding where operating pressures are high; where heat resistance, additional strength, or minimum stretch are essential. But remember this . . . *the same features that make* I.W.R.C. *best for the tough spots help make it the longest-performing and most economical specification for a wide range of applications!*

As rotary drilling lines, Roebling 6 x 19 Preformed "Blue Center" Steel Wire Rope with I.W.R.C. has demonstrated *extra* life on the job and substantial dollar savings. And, of course, Roebling Preformed construction brings greater ease of handling, top flexibility, less tendency to kink or foul.

Have your Roebling Field Man help select the *right* rope for your special requirements. John A. Roebling's Sons Company, Trenton 2, New Jersey.

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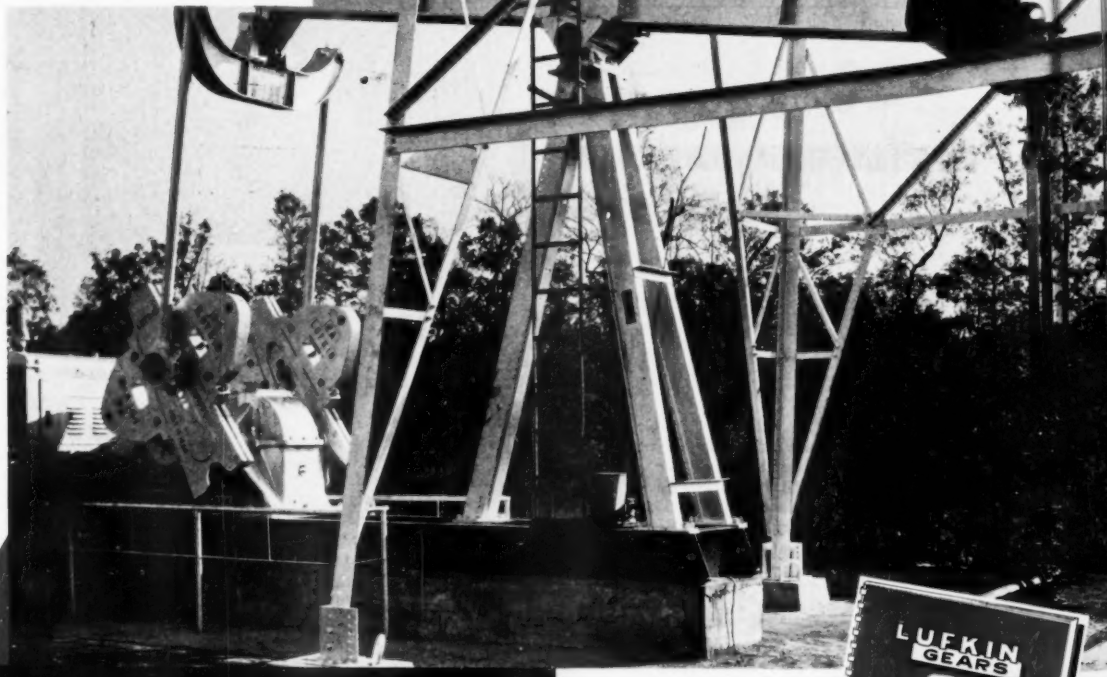
IT'S THE Lufkin Line

The modern compact, expertly engineered Lufkin Unit is easily recognized "the unit apart" from all competition.

Lufkin pioneered and developed the application of reduction gears for oil well pumping. The experience gained in this pioneering effort, plus the continued search for improvement in design and construction has definitely placed the Lufkin Line out front every time.



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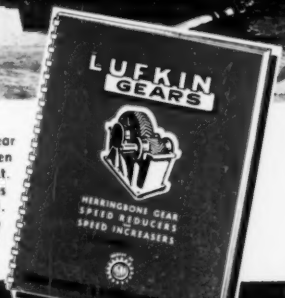
More than 60,000 complete gear reducers and increasers have been manufactured in our Lufkin plant. The complete line specifications are contained in Catalog G-1. Write for your copy today. No obligation whatsoever!



LUFKIN PUMPING UNITS

LUFKIN-COOPER-BESSEMER ENGINES

LUFKIN OIL FIELD AND INDUSTRIAL TRUCK TRAILERS

INDUSTRIAL SPEED REDUCERS AND INCREASERS

DIVISION LUFKIN FOUNDRY & MACHINE COMPANY INDUSTRIAL, MILL AND AUTOMOTIVE SUPPLIES

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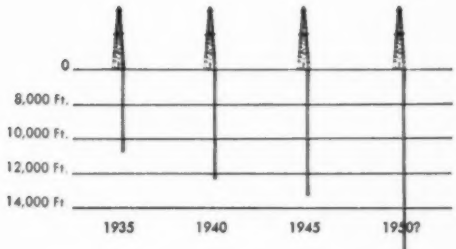

THE *New* PATTERSON-BALLAGH PROTECTOR

• Year by year, the depth of oil wells increases. To withstand the abuses that deeper drilling imposes on casing and drill pipe protectors, Patterson-Ballagh has developed this new shock-proof, tear-resistant Casing Protector.

This new Protector gives outstanding service because it has been engineered to take full advantage of the rugged quality of field proven Patterson-Ballagh Rubber. Field and laboratory tests in great number have been made. The extent to which the useful life of rubber is shortened has been determined. The new Patterson-Ballagh Protector was designed as a result of these tests. Results—longer protector life not heretofore thought possible under adverse drilling conditions.

There is a specially designed Patterson-Ballagh Casing Protector for each size of drill pipe. There is no overstressing, or slip, from lack of grip—each Patterson-Ballagh Protector is *designed for one, and only one, size drill pipe.* When mounted, the tapered end recesses reduce the stress at these vulnerable points. This gives the Protector a margin of safety that allows it to absorb the shock, cuts, and wear of deeper drilling. For Casing Protectors that last, and L-A-S-T and L — A — S — T, call your Patterson-Ballagh man.

Tapered recesses at both ends guarantee less stretching when Protector is installed, thereby giving both ends shock and tear-resistant qualities.

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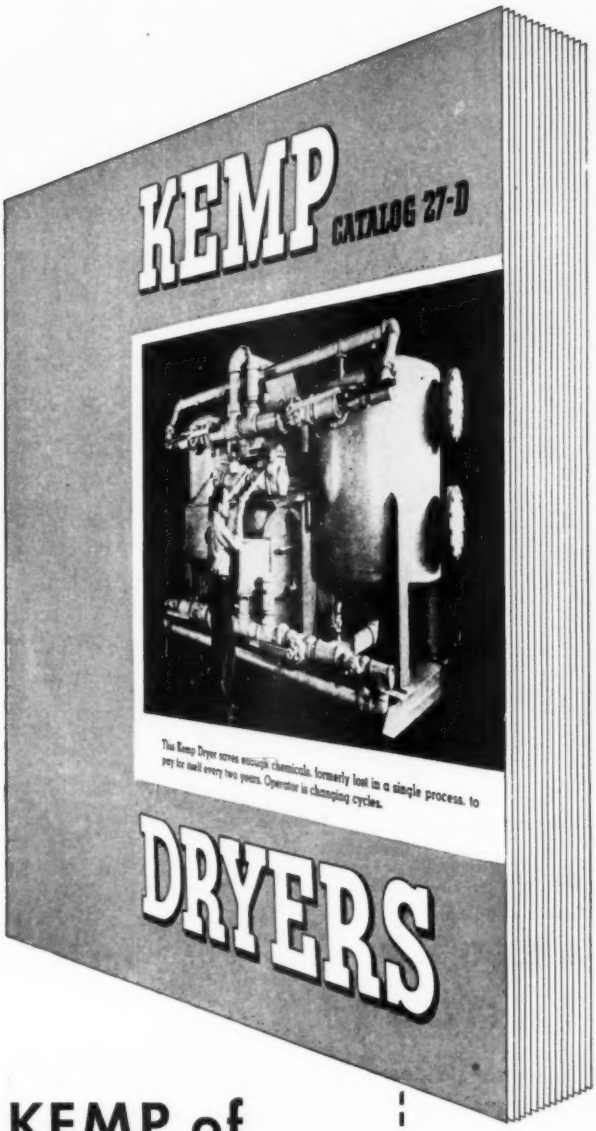
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The Kemp Dryer saves enough chemicals, formerly lost in a single process, to pay for itself every two years. Operator is changing cycles.
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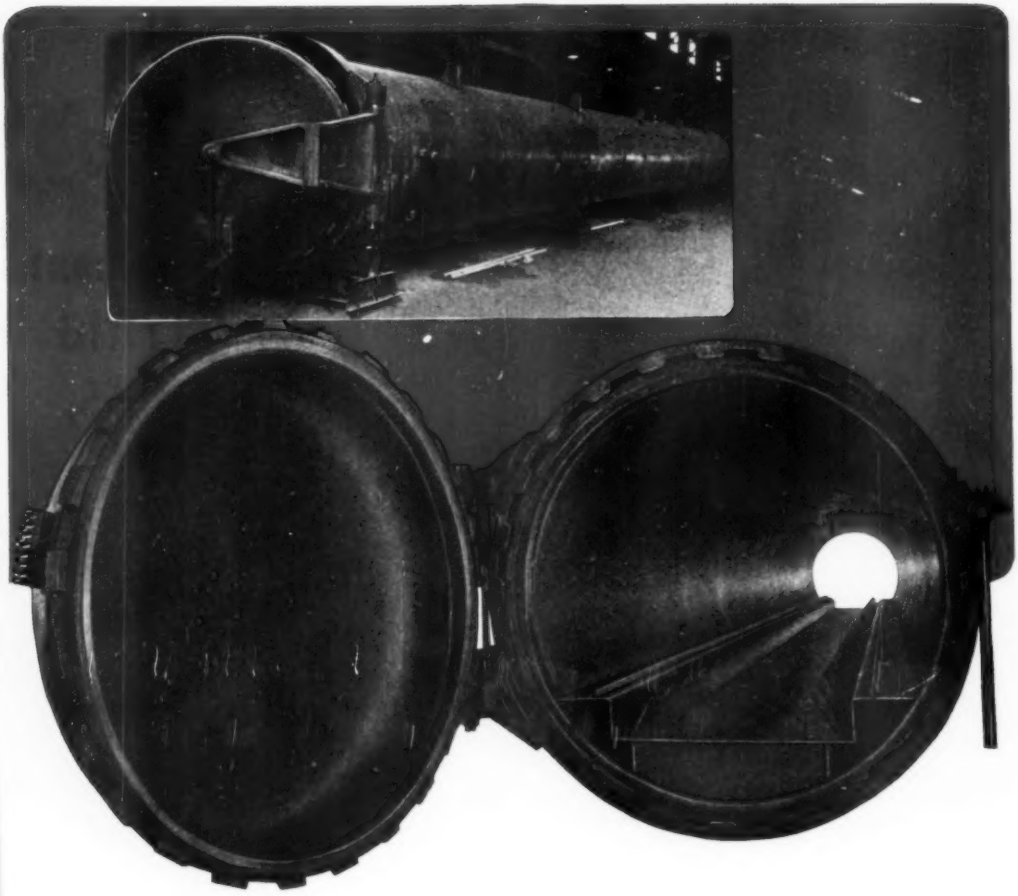

Autoclave USED IN THE CHEMICAL INDUSTRY

Manufactured for the Ruberoid Company, this Autoclave is 78 inches in diameter by eighty feet in length. Large and specialized equipment of this kind is handled as routine fabrication at the Dallas Tank Company, Inc.

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DALLAS TANK COMPANY, INC.

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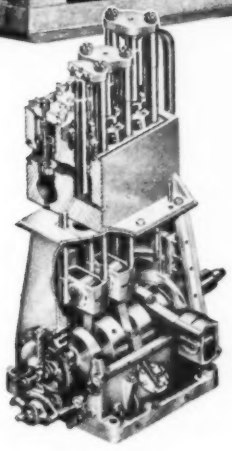
STAYING POWER

An all purpose pump—
The Aldrich Inverted Triplex



Mountains . . . there's rugged grandeur in a range of mountains—and staying power!

There's a similar power in the Aldrich range of high pressure pumps. Every industrial or engineering specialist knows that machinery must have *staying power*—the ability to maintain top performance and high efficiency over long periods of time. They know that interruptions are costly, while *staying power* pays. Aldrich Pumps have that *staying power!*

Take a look at the Aldrich design and construction that make rugged service easy. Note the plungers above the crankshaft, which provide for simplified drive—through speed-reducers or by direct coupling to a driver located on the floor. Expensive foundations are eliminated.

Wherever high pressure pumping is required—and Aldrich Pumps are used—the result is lasting service. Write now for complete technical information. Request Data Sheet 66.

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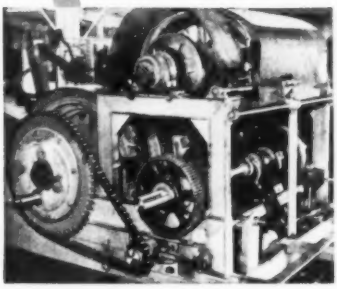
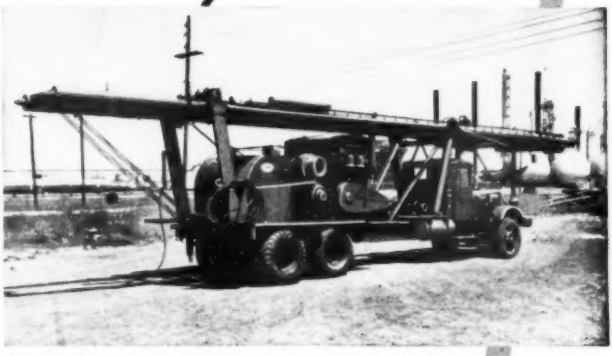
THE ALDRICH PUMP COMPANY

9 GORDON STREET, ALLENTOWN, PENNSYLVANIA

The **FIRST** *Name in Reciprocating Pumps*

MORSE Roller Chain *fits the picture*





Morse Roller Chain—flexible, rugged, economical—meets the exacting demands of the best petroleum equipment manufactured. It is used on this truck-mounted 4000′ single drum rotary Wichtex, made by the Wichtex Machinery Company, Wichita Falls, Texas.

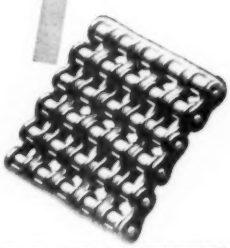
ALMOST any petroleum equipment can improve its performance picture by the use of Morse mechanical power transmission products.

Here's just one instance where this is proved. Morse Roller Chain, used by the Wichtex Company in its single and double drum rotary drills, helps to maintain top performance through dependable power transmission.

Petroleum equipment manufacturers choose Morse Roller Chain time and again for their mechanical power drives. They know it will stand up under the gruelling punishment machinery must take in drilling operations. And they know it to be an efficient, flexible drive which gives long, trouble-free service life and low-cost, positive power transmission.

Morse Roller Chain is manufactured in all American Standard pitches and widths. Morse sprockets embody Morse's designing and engineering skill. Mass-production facilities and modern equipment result in accurate quantity production at low cost.

Check on Morse Roller Chain for possible improvement in the mechanical power transmission in your equipment. And remember that replacement chains are immediately available in distributor's stocks near-by. Write for details, Dept. 382, Morse Chain Company, Detroit 8, Michigan.



Morse Morflex Coupling

MORSE

MECHANICAL

POWER TRANSMISSION

PRODUCTS

A PRODUCT OF B-W BORG-WARNER

Morse Silent Chain Drives

Morse-Rockford Clutches

Morse-Rockford Pullmore Clutches

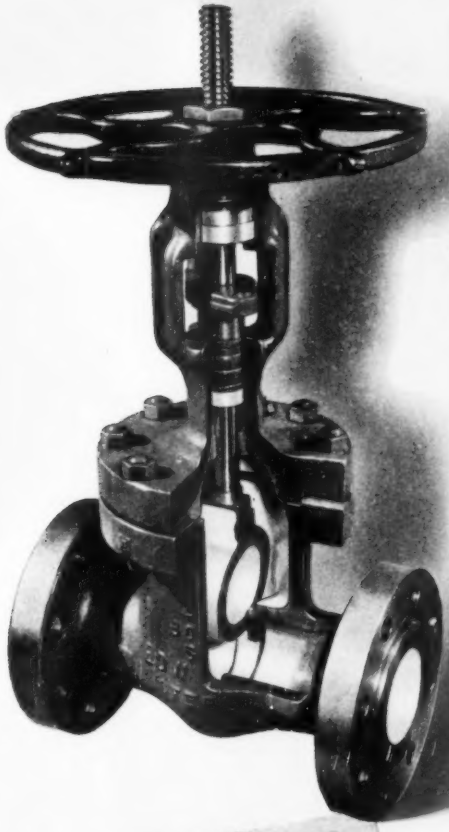
MORSE CHAIN COMPANY DETROIT 8, MICHIGAN

BRANCH OFFICE AND WAREHOUSE, 1308 LA BRANCH, HOUSTON, TEXAS

A New, Better

GATE VALVE

by EDWARD



In contrast with traditional gate valve design, guide ribs in Edward gate valves are accurately located with respect to seat faces and wedge, then welded integrally to body with continuous weld fillets. Clearances are thus cut to minimum and wedge can travel practically to closed position before touching seats, greatly reducing wear.

Basically different in design, Edward cast steel gate valves are tight, *stay* tighter than you thought gate valves could.

Here at last is a gate valve with all working parts in perfect alignment. Close fitting guide ribs, located *after* seat rings and wedge are in place, prevent wedge drag on seat faces. Hard faced seats are integral with body, yet replaceable. And with the new Edward gate valve testing method, *both* seating faces must be tight simultaneously.

The new Edward gate valves are built in 2½ to 12 in. sizes for service from 150 to 3600 lb. In many sizes and pressure classes they are available for immediate shipment.

Catalog Now Ready

First edition of Edward cast steel gate valve Catalog 12-E with illustrations, dimensions and descriptions of 300, 600, 900, 1500 lb sp gate valves is now ready. Write for a copy for your files today.

EDWARD VALVES, INC. • EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES

Thread 2" pipe in 22 seconds with TOLEDO POWER PIPE MACHINES!

● *You can save up to 80% on pipe threading time*—by using a portable TOLEDO No. 999 Power Pipe Machine instead of hand methods! This saves labor... reduces costs!

The Super Model threads 2" pipe in 22 seconds... or 30 seconds with Standard Model. Cuts off 2" pipe in 10 seconds. Combines speed, production, strength, compactness, portability, dependability and low cost! Ask your distributor for complete details and price. Write for new catalog. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

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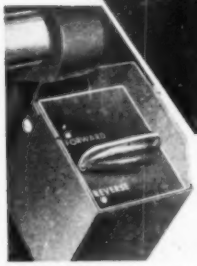
TOLEDO

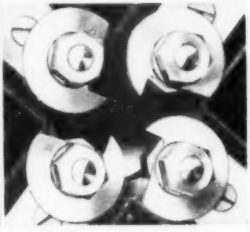
FOR PRECISION PIPE TOOLS



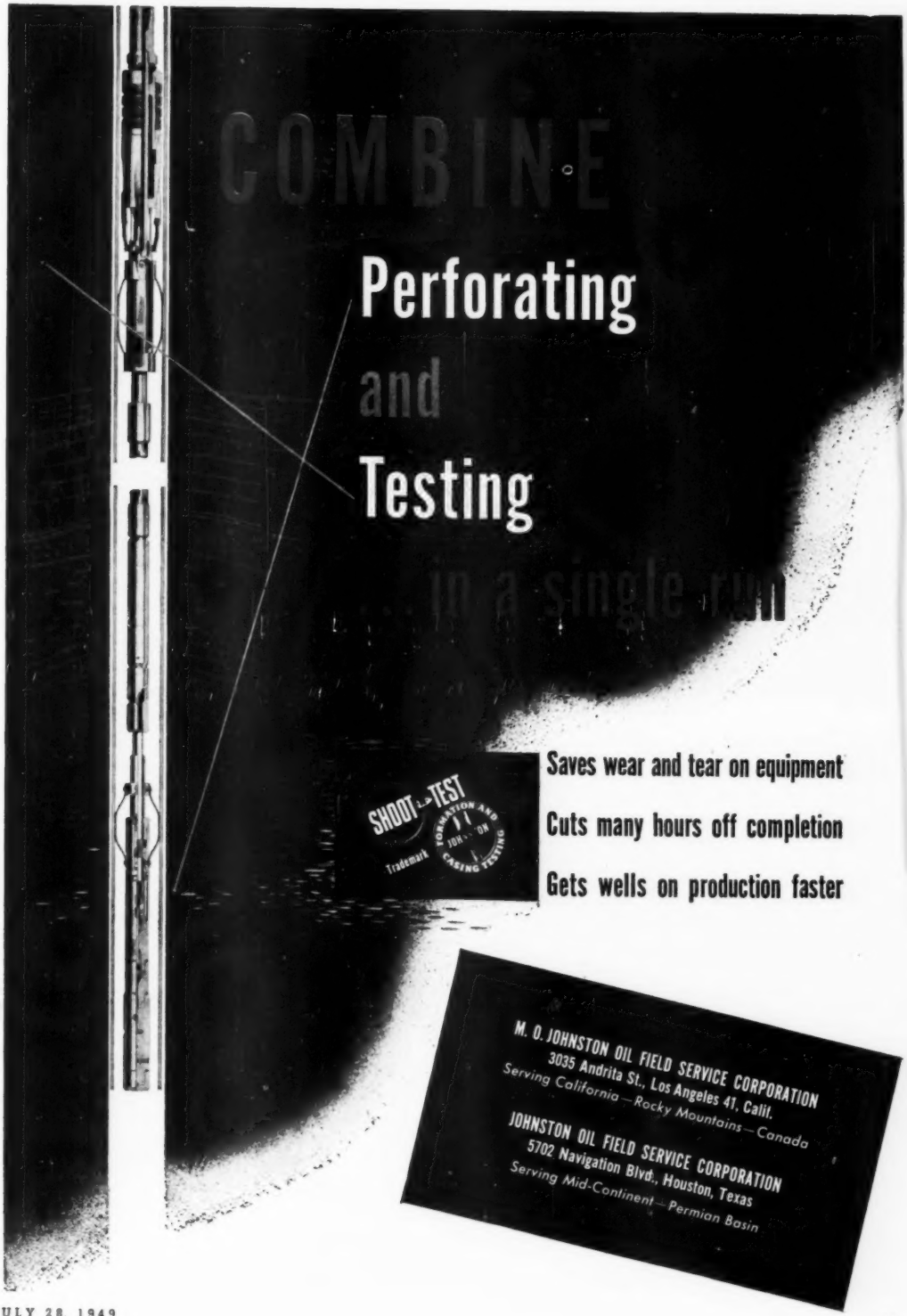
CONTROLS... entirely within forward and reversing switch. Speed adjusted automatically.

REAMING... with 12 tooth cone type fluted reamer mounted on arm on cutter head.

THREADING... speedy, accurate. Thread gauge shows length of thread being cut.



CUTTING... especially fast with 4 cutting knives. Perfect square end cuts. No burred edges.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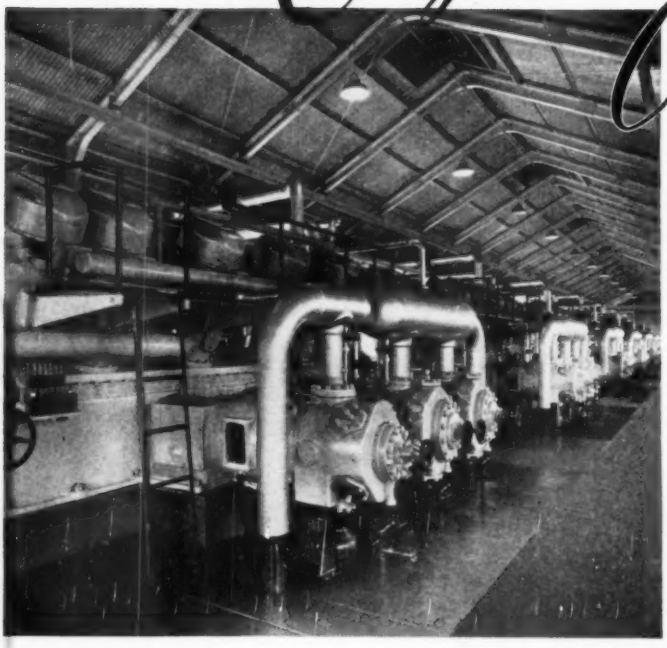
BACK OF *Every* INGERSOLL-RAND *Compressor* ARE THESE *Sup[R]values*



This 7000-hp installation of Ingersoll-Rand KVG 4-cycle V-angle gas-powered compressors serves a natural-gas conservation program. The gas is gathered from producing oil wells and stripped of its liquid content. The high-pressure residue gas is then distributed to industrial centers where it is fully utilized.

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[R] **Experience and Know-how** to build compressors for *any* pressure, *any* gas, *any* size, *any* service.

[R] **Facilities** *second to none*... for design, research, metallurgy, and manufacture.

[R] **Range of sizes** . . . with *standardized* frames, running gears and interchangeable cylinders ...plus *special* cylinders, valves and coolers for special applications.

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[R] **Trained Personnel** ...men who *know* Air Power...who build, sell, and service air drills and tools as well as compressors.

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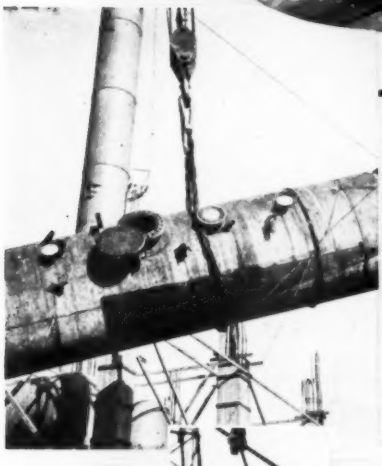

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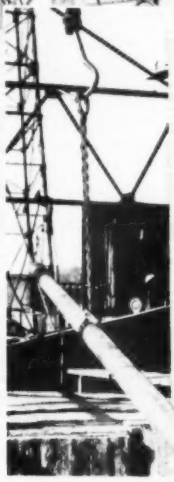
*PATENTS: U.S., [illegible]; CANADA, [illegible]; FOREIGN, CANADIAN, [illegible]



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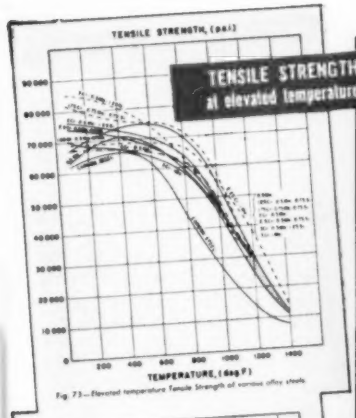
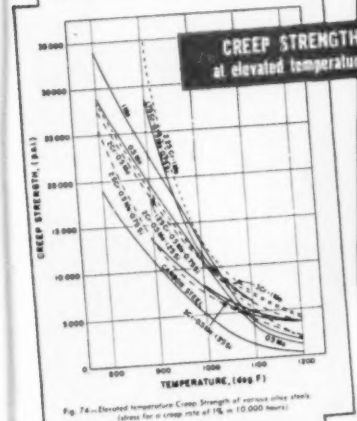
The low-down on alloy steels



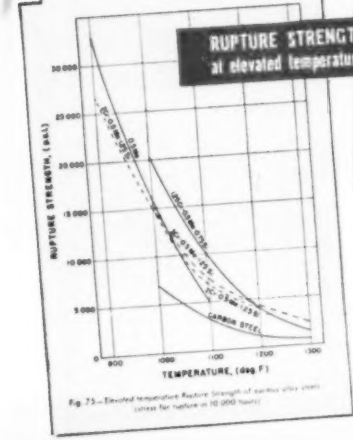
TENSILE STRENGTH at elevated temperatures

Fig. 73—Elevated temperature Tensile Strength of various alloy steels.



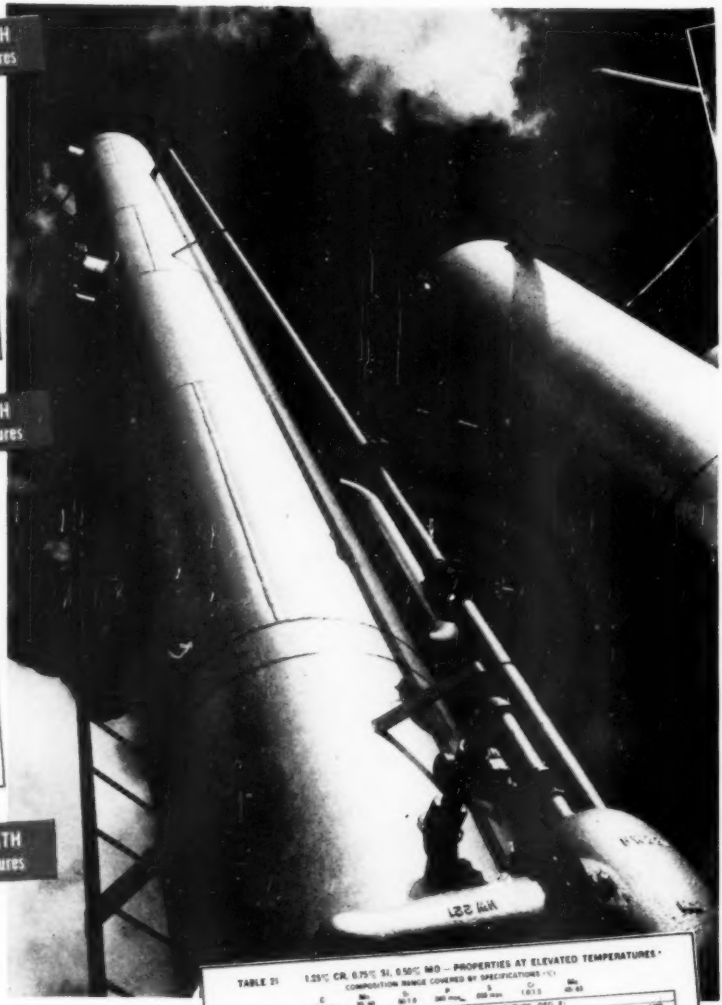
CREEP STRENGTH at elevated temperatures

Fig. 74—Elevated temperature Creep Strength of various alloy steels. (stress for a creep rate of 1% in 10,000 hours)



RUPTURE STRENGTH at elevated temperatures

Fig. 75—Elevated temperature Rupture Strength of various alloy steels. (stress for rupture in 10,000 hours)



These are a few of the informative charts included in the 18-page section devoted to High Temperature Steels in our new Carilloy handbook. A copy will be sent you on request.

TABLE 21 0.25% CR, 0.75% Si, 0.50% MO — PROPERTIES AT ELEVATED TEMPERATURES*

COMPOSITION RANGE COVERED BY SPECIFICATIONS (%):

C	Mn	Si	P	S	Cr	Mo
.10 max.	.30-.60	.50-1.0	.040 max.	.040 max.	1.0-1.5	.45-.65

PROPERTY	TEMPERATURE, DEG. F						
	700	800	900	1000	1100	1200	1300	1400
ASME MAXIMUM ALLOWABLE STRESS (1000 psi)	12.0 (12.5-14.3)	11.0 (10.7-11.7)	10.0 (9.6-10.7)	5.05 (4.7-5.5)	2.2 (2.0-2.5)	60-67.5) 66	(27.33) 30	(17-22.5) 20	(11-13.5) 12
TENSILE STRENGTH (1000 psi)		78-79.5	75.5-77	29.5-31.5	23-25.5	(18-19) 17.5	11	7
YIELD STRENGTH (1000 psi)		32.5 (23.30) 25	(24-25) 25	(16-21) 25	(9-14) 20	(12.50) 60	91	72
ELONGATION (% in 2")		84	85	76	82.5	85	94	98
REDUCTION OF AREA (%)					(8-22.5) 6	(15-17.5) 7.5		
CREEP STRENGTH 1% in 10,000 hours (1000 psi)		(27-29) 28	(17-25) 20.5	12				
CREEP STRENGTH 1.0 in 100,000 hours (1000 psi)		29.5	16.5	(9-13) 8.5	(3-4.5) 5	(0.8-2) 1.2		
RUPTURE STRENGTH (100 hours-1000 psi)						7	2.8	0.9
RUPTURE STRENGTH 10,000 hours-1000 psi)					10.8	4	1.3	0.4
OXIDATION—Weight loss in grams per square inch after 100 hours in air at the indicated temperature)	nil	nil	nil	02	.07	.26	.87	1.19
LINEAR THERMAL EXPANSION inches per foot—from 70 F to the indicated temperature)		080		087		110		

* Values in parentheses show spread of available data, and accompanying single values are a considered average of the data. Single values, only, represent limited data.

for high temperature service

If you are building oil stills or cracking units, pressure tanks, steam turbines, boilers, superheaters, pumps, valves and piping, that must operate under high heat and high pressure—*we can help you.*

To obtain better yields, greater speed, and lower production costs, industry in recent years has been forced to higher and higher temperatures and pressures.

For that reason factual data on the behavior of steel under stress at elevated temperatures is of prime importance. Particularly is this so because, at high temperatures, steel flows or "creeps" continuously under operating stresses. This behavior can have disconcerting effects unless the designer has the proper information to guide him in his selection of steel.

That is why for years we have concentrated on digging out the facts about steel behavior at high temperatures. And because the "long-time" creep test is the most significant, our research laboratories have conducted literally thousands of such tests, many of them running into hundreds or even thousands of hours.

The results obtained have shown us not only how to avoid failures at elevated temperatures but have led to the development of new and stronger steels for such operation.

The U·S·S Carilloy Steels recommended for high temperature applications have a demonstrated high resistance to creep. They maintain strength at high heat. They can be heat treated to develop optimum properties. In addition they offer a wide flexibility in selection so that the qualities desired can be secured to whatever extent called for by the design. To assist you in their most economical application, the cooperation of our metallurgists, who played a major part in developing these steels, is freely at your service.

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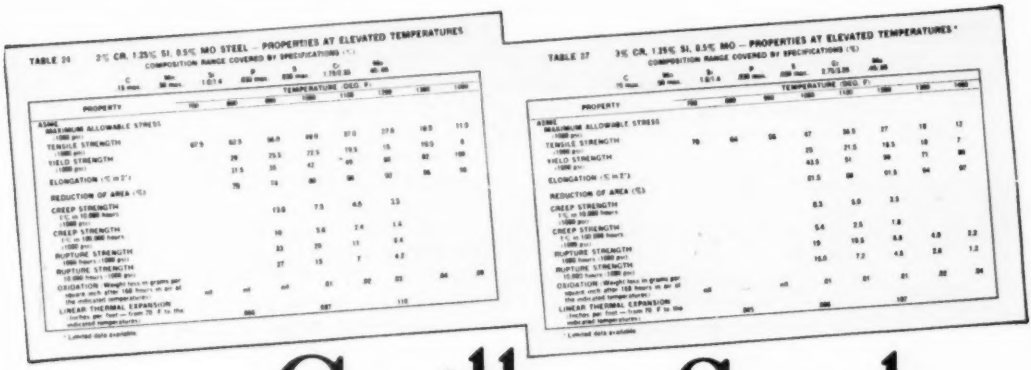

TABLE 26 3½ CR, 1.25% SI, 0.5% MO STEEL — PROPERTIES AT ELEVATED TEMPERATURES

COMPOSITION RANGE COVERED BY SPECIFICATIONS (%)

C	Mn	Si	P	S	Cr	Mo
to 15 max.	30 to 80 max.	1.00 to 1.50	030 max.	030 max.	2.75 to 3.25	.40 to .65

PROPERTY	TEMPERATURE (DEG. F)							
	750	800	850	900	950	1000	1050	1100
ASME MAXIMUM ALLOWABLE STRESS (1000 psi)								
TENSILE STRENGTH (1000 psi)	67.5	62.5	56.0	49.0	37.0	27.0	18.0	11.0
YIELD STRENGTH (1000 psi)		29	25.5	22.5	19.5	15	10.0	6
ELONGATION (% in 2")		31.5	35	42	49	60	82	105
REDUCTION OF AREA (%)		75	74	80	86	90	95	98
CREEP STRENGTH (% in 10,000 hours) (1000 psi)			13.0	7.5	4.5	2.5		
CREEP STRENGTH (% in 100,000 hours) (1000 psi)			10	5.6	2.4	1.4		
RUPTURE STRENGTH (1000 hours) (1000 psi)			33	20	11	6.4		
RUPTURE STRENGTH (10,000 hours) (1000 psi)			27	15	7	4.2		
OXIDATION (Weight loss in grams per square inch after 168 hours in air at the indicated temperature)	nil	nil	nil	.01	.02	.03	.04	.08
LINEAR THERMAL EXPANSION (inches per foot — from 70 F to the indicated temperature)			080		087		110	

* Limited data available.

TABLE 27 3½ CR, 1.25% SI, 0.5% MO — PROPERTIES AT ELEVATED TEMPERATURES*

COMPOSITION RANGE COVERED BY SPECIFICATIONS (%)

C	Mn	Si	P	S	Cr	Mo
to 15 max.	30 to 80 max.	1.00 to 1.50	030 max.	030 max.	2.75 to 3.25	.40 to .65

PROPERTY	TEMPERATURE (DEG. F)							
	750	800	850	900	950	1000	1050	1100
ASME MAXIMUM ALLOWABLE STRESS (1000 psi)								
TENSILE STRENGTH (1000 psi)	70	64	56	47	36.0	27	18	12
YIELD STRENGTH (1000 psi)				25	21.0	16.5	10	7
ELONGATION (% in 2")				43.5	51	66	71	86
REDUCTION OF AREA (%)				81.0	88	91.5	94	97
CREEP STRENGTH (% in 10,000 hours) (1000 psi)				8.5	5.0	3.5		
CREEP STRENGTH (% in 100,000 hours) (1000 psi)				5.4	3.5	1.8		
RUPTURE STRENGTH (1000 hours) (1000 psi)				19	10.5	6.8	4.0	2.2
RUPTURE STRENGTH (10,000 hours) (1000 psi)				10.0	7.2	4.5	2.6	1.2
OXIDATION (Weight loss in grams per square inch after 168 hours in air at the indicated temperature)	nil		nil	.01	.01	.01	.02	.04
LINEAR THERMAL EXPANSION (inches per foot — from 70 F to the indicated temperature)			085		096		107	

* Limited data available.

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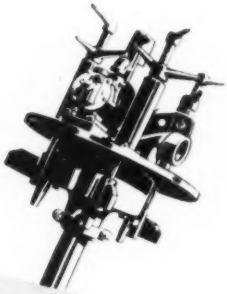

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Spray nozzles of the Oakite Interior Tank-Cleaning Unit move together. They rotate both vertically and horizontally with the result that soiled surfaces receive direct-impact spray every 15 minutes. Operation, after installation, is entirely automatic. Unit is also used for rinsing, after cleaning. And it may be used for stripping paint.

Ask your nearby Oakite Technical Service Representative, for complete operational data on this unit, including solution concentrations, temperatures, pressures, spraying and rinsing time for different types of tank cars and deposits. Free, without obligation. Do it today!

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These sturdy GM Diesels can be depended upon to do their job smoothly, efficiently and with a minimum of attention. Their 2-cycle principle with power on every downstroke produces more power with less bulk. They start quickly and run smoothly with instant response to varying power demands. Their simplified construction and clean design make maintenance a simple matter.

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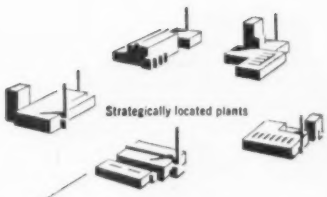

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NOT ON PARKERSBURG TREATERS

This exclusive feature of Parkersburg Emulsion Treaters preserves the gravity of your oil . . . eliminates the necessity of expensive, less efficient outside pre-heating or cooling equipment.

As a result of Parkersburg's exclusive double-jacketed construction, emulsion is preheated in the treater as it travels down the annulus between the outer shell and the warmer inner shell of the oil settling space. The clean oil is gradually cooled as it travels up through the treater. Volatile components are condensed and returned to the oil before it is discharged to storage.

In addition to their built-in heat exchanger Parkersburg Treaters have: Two Oil Settling Compartments; Built-in Free Water Knockout; Refinery Type Mist Extractor; Provision for Recycling Hot Water and mixing it with incoming well fluid; Heating element that is practically 100% proof against hot spots and scale deposits.

For dependable, efficient, economical performance . . . for a better-built treater, talk to your nearest Parkersburg Representative.

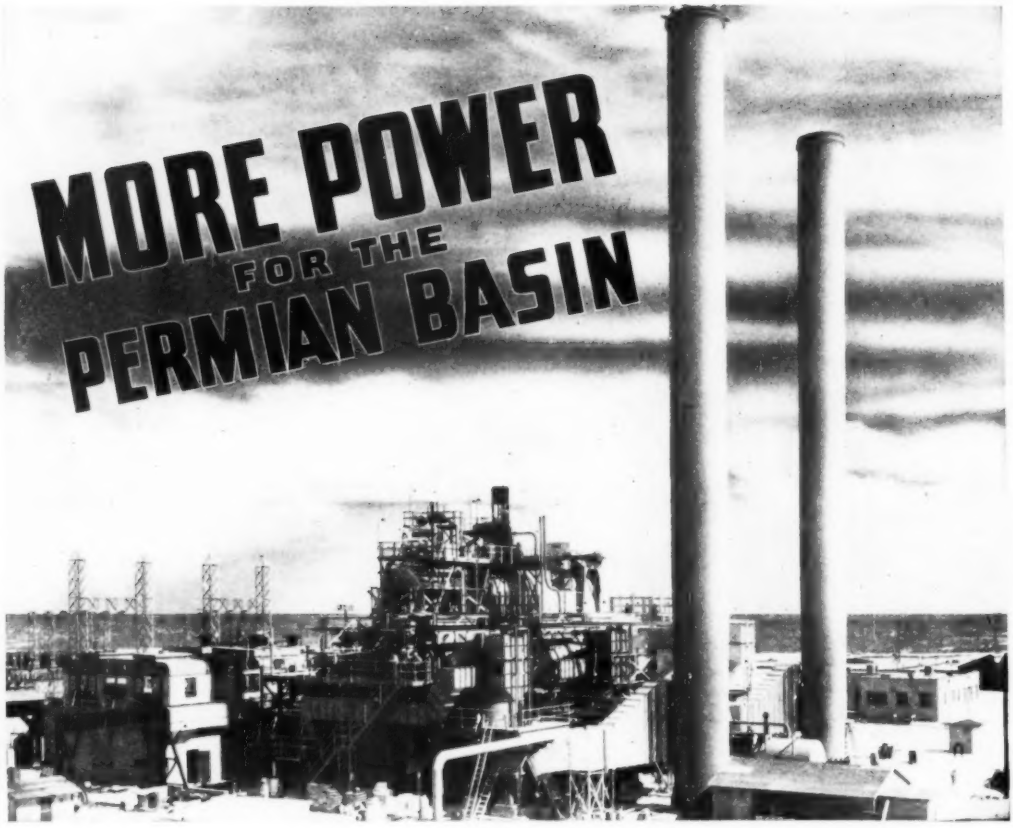
THE PARKERSBURG RIG & REEL CO.

PARKERSBURG & OCS PRODUCTS

GENERAL OFFICES, PARKERSBURG, W. VA.
Plants at Parkersburg, W. Va., Coffeyville, Kan., Houston, Texas
District Offices:
Dallas - Houston - Los Angeles - Tulsa - New York

OCS

PARKERSBURG



• In the heart of the Permian Basin, on a section of land which up to a couple of years ago, had been inhabited mainly by jackrabbits, coyotes and road-runners, there are big things going on.

Right where you would least expect it, Texas Electric Service Company has built the new, stream-lined Permian Basin steam power plant of 50,000 kilowatts capacity, half of which — 25,000 kilowatts — has been on the line since last June, serving the many and varied industrial, residential and commercial enterprises of this great and growing area. The other half — the second two generating units of 12,500 kilowatts each — has just been completed.

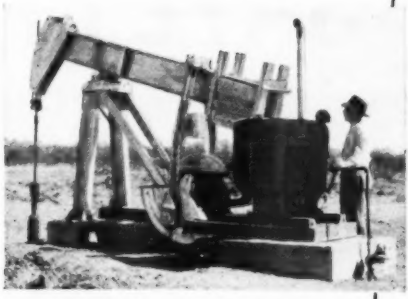
In addition to this ultra-modern power plant, other expansion developments of Texas Electric Service Company have included new transmission and distribution lines — new and enlarged substations — and other new and improved electric power service facilities to make this additional power available whenever and wherever in the Permian Basin area it is needed.

The power system of Texas Electric Service Company has for many years supplied electric power for well pumping, pipe line pumping, refining and well drilling in many Permian Basin oil fields. Electric power, through these many years, has been one of the greatest single aids in the development of the Permian Basin's oil potentials.

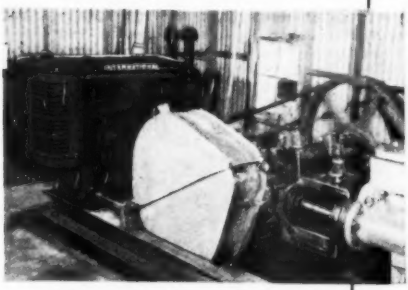
TEXAS ELECTRIC SERVICE COMPANY

General Office: Fort Worth

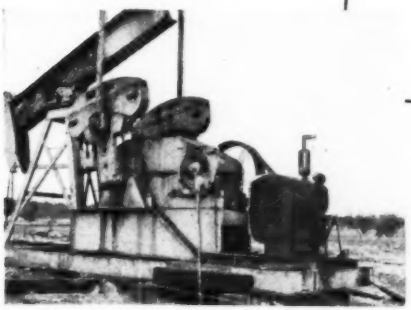
"We decided to Standardize on INTERNATIONAL POWER UNITS"



A 1,000-foot water well powered by an International U-4 gas engine on the Woodson Water Flood in Throckmorton County, Texas. One of ten U-4's operated by Jack B. Robert.



An International U-6 gas engine powering a 3½" x 10" double-acting pump, forcing water into a header and injection lines on a water injection system.



An International U-4 powering a jack on a 6,012-ft. oil well on the A. E. Smith lease in Stonewall County, Texas, for Jack B. Robert.

JACK B. ROBERT
BRECKENRIDGE, TEXAS

February 7, 1949

H. R. Carlson
Asst. Dist. Manager Industrial
International Harvester Company
1809 South Lamar Street
Dallas, Texas

Dear Sir:

Since 1942 we have been using several U-4 International power units, as well as several competitive units. In the latter part of 1947 we found that our operations would require the purchase of several new power units. At that time we decided to standardize on one type of power unit. In order to decide which power unit would be the best, we talked to the pumpers using the various units and also determined from our records the maintenance cost of the various units. The following record of one of our U-4's is typical of why we decided to standardize on International Power Units:

A U-4 International on a No. 8 Jensen Pumping Unit, pumping two 2500 ft. wells 12 hours per day, ran 4 years without a major overhaul, has run one year since then, and is still running fine. The maintenance cost over the five-year period was an average of $81.66 per year including the major overhaul cost (replacing sleeves, pistons, and all bearings).

We are now using two U-6's, ten U-4's, and one U-2, and plan to use more as our operations require them.

Yours very truly,

Thomas A. Ford

THOMAS A. FORD
Production Supt.
Jack B. Robert
Independent Oil Producer

taf/jjb

IN EVERY WAY you'll find that International multi-cylinder engines give you more for your money. High in performance, low in maintenance—dependable on every count—International engines and power units are the choice of the power-wise. See your International Industrial Distributor, Power Unit Dealer or Supply House. It Pays to Standardize on International.

INTERNATIONAL HARVESTER COMPANY • Chicago

CRAWLER TRACTORS
WHEEL TRACTORS
DIESEL ENGINES
POWER UNITS

INTERNATIONAL HARVESTER

INTERNATIONAL INDUSTRIAL POWER

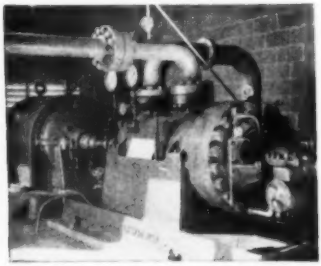
FIDO BLAZES NEW ERA OF AVIATION SAFETY

FIDO, born in war, guards against fog

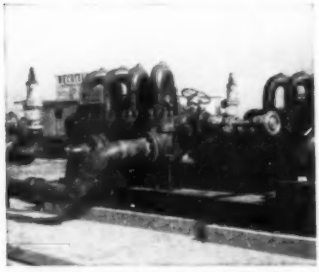
Mayor Fletcher Bowron lit the pilot light and Los Angeles was cooking on the front burner in world aviation circles at the inauguration of FIDO (Fog, intensive dispersal of) for the Los Angeles Municipal Airport.

Pushing a bright red button, the Mayor flashed on Los Angeles' $842,000.00 fog dispersal system and this field became the first all-weather commercial airport in the world. Brilliant orange flames leaped up simultaneously into the dusk from the burners outlining the approach and runway.

Backed by 5 millions spent in research by the Army, Navy, and civilian interests,



BYRON JACKSON "FIDO" PUMP installed at Los Angeles Municipal Airport.



ORIGINAL BYRON JACKSON "FIDO" pump installed at Arcata, Northern California, in 1945.

PLANELOAD OF NEWSMEN AND PHOTOGRAPHERS MAKE PERFECT TOUCHDOWN while Los Angeles FIDO system singes off imaginary fog in first acceptance test of fog dispersal system. FIDO system pumps cheap diesel fuel to atomizers spaced along 6,000-ft. flame rows.

FIDO assures airport operation at zero ceiling. The sky-pointed flame throwers are designed to burn off fog to heights of 400 feet in the 2000-foot approach zone, to 250 feet in the 1000-foot landing zone, and from 75 to 300 feet over the 3000 feet of remaining runway.

More than six miles of fuel pipelines outline the FIDO landing area. The heart of this system is located in a small quonset hut. Here, the Byron Jackson 1000 hp FIDO Pumps keep a pressure of 1200 pounds per square inch in the system. The pressures involved make possible complete combustion and the height of flame at the atomizers.

In lauding the Board of Airport Commissioners and others who had worked out this latest safety device for aviation, Mayor Bowron declared it is "this spirit which is hastening the day when we will have the world's safest airport."

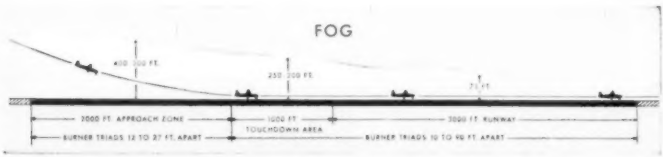
"Air travelers throughout the world," said Bowron, "soon will know they will always land on schedule at Los Angeles."

This advertisement conforms to the splendid coverage given this event, March 30, 1949, by the Los Angeles Daily News.

MAYOR FLETCHER BOWRON LIT THE pilot light that made aviation history. With him (right) is Col. Clarence M. Young, General Manager of the Los Angeles Municipal Airport.

Byron Jackson Co. designs, builds, and installs every type of centrifugal pump for city, farm, and industrial requirements. For complete information, write for illustrated BJ Bulletins describing the pumps you need.

Byron Jackson Co.
Since 1872
LOS ANGELES 54, CALIFORNIA
Offices and dealers in principal cities



THIS IS HOW LOS ANGELES MUNICIPAL AIRPORT'S FIDO SYSTEM WILL BURN away zero ceilings, permit planes to land with safety, and effect bad weather economies.

WORLD'S MIGHTIEST MAKER of CHEMICAL FOAM!

Fifty percent more fire-fighting foam. Think what that means! Yes, Sir! 450 gallons or more of tough, clinging, long lasting Firefoam and instantly available through scientific tank-top metering to subdue roaring-hot oil fires.

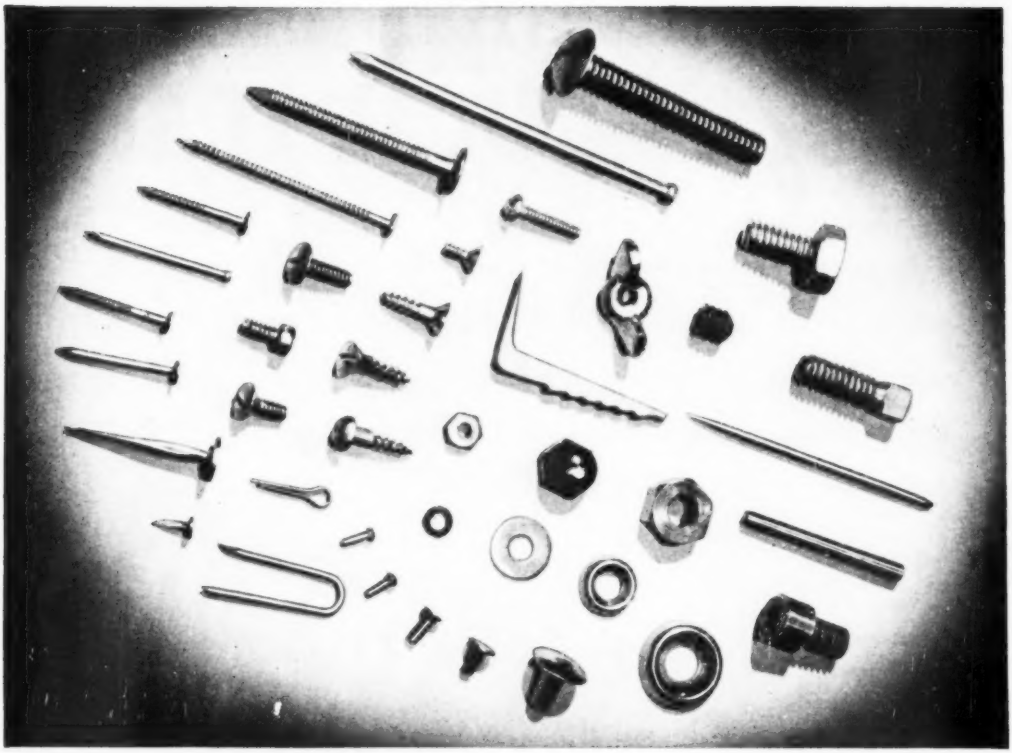
Write for safety-assuring details, contained in an 8-page brochure

Outdoor model illustrated. Also available, models for indoor and yard service, with running gear adapted for easy mobility.

OUR 2nd Century of Leadership in FIRE PROTECTION

AMERICAN-LAFRANCE-FOAMITE Corporation

ELMIRA · NEW YORK



40 Ways To Use Foresight, Not Hindsight!

How A Truck Body Company Put Monel Fastenings To Work

As auto trucks go rolling along the highway, their bodies tend to loosen up at corners and other critical joints. But vibration doesn't loosen the joints in the truck bodies built by one company we know. This company uses a patented Monel fastening. It's the Monel "Anchorfast" nail made by Independent Nail and Packing Co., Bridgewater, Mass. This fastening goes in like a nail, but its grooved shank makes it hold like a screw. Vibration will never cause it to "back out."

IF YOU HAVE A TOUGH JOB FOR FASTENINGS, START RIGHT. GIVE THE JOB TO DURABLE MONEL FASTENINGS

Give your "easy jobs" to ordinary fastenings.

But recognize your "tough jobs," and beat them with Monel*. For any Monel fastening will give you extra protection against corrosion... rust ... overstressing ... vibration ... shock ... heat ... cold.

If corrosion is ruining your fastenings, switch to Monel. It resists attack by alkalies, salts and most acids. It can never rust.

If your failures are physical, compare the mechanical properties of Monel with the free-cutting steel used in ordinary fastenings. Monel is 20% *stronger* ... 30% *more ductile* ... 40% *tougher.*

If extreme operating temperatures are a problem, relax with Monel. A Monel fastening is safe at elevated temperatures or at liquid air cold.

Any type fastening you need is available in longer-lasting Monel.

Surely, there are many places in your plant or product where you want (*and need*) the extra advantages of Monel fastenings.

TEST A MONEL FASTENING, FREE! Write to Bob Johnson of Inco. Tell him your problem and the type and size you need. He'll send a sample ... plus the address of your nearest supplier.

EMBLEM OF SERVICE INCO

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street, New York 5, N. Y.

*Reg. U. S. Pat. Off.

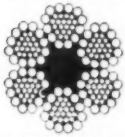
Monel* Fastenings are stronger..tougher..safer

-Preformed-
"HERCULES"
REG. U.S. PAT. OFF.
RED-STRAND
WIRE ROPE

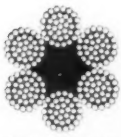
Easy to Handle . . . Safe and Economical to Use

6 x 19 Filler Wire
Fiber Core

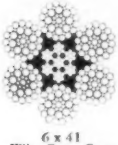
6 x 19 Seale
Wire Rope Core



Style G-Flattened Strand
Fiber Core



6 x 37 Filler Wire
Fiber Core



6 x 41
Wire Rope Core

"HERCULES" (Red-Strand) Wire Rope has proved its worth by the accurate yardstick of actual performance. For over 60 years the Red-Strand has been a dependable guide to safe and economical wire rope service. Now in the Preformed type, a plus value has been added. As internal stresses are largely eliminated, the rope is less apt to kink . . . it is easier to handle . . . it spools better. But these are not the only advantages. Because internal stresses have been reduced there is less internal wear and more resistance to bending fatigue, which means longer life.

Another and an ever important factor in determining wire rope life is the use of the right construction for the work the rope is to do. To meet this situation, Preformed "HERCULES" (Red-Strand) Wire Rope is made in a wide range of both Round Strand and Flattened Strand constructions. There is a correct type for any heavy duty job. Our Engineering Department will be glad to help you make the right selection.

We invite your inquiries.

"HERCULES"
RED-STRAND
the DEPENDABLE
WIRE ROPE
for any TOUGH JOB
® REG. U.S. PAT. OFF.

MADE ONLY BY

A. LESCHEN & SONS ROPE CO.

ESTABLISHED 1857

5909 KENNERLY AVENUE • ST. LOUIS 12, MISSOURI

NEW YORK 6 • CHICAGO 7 • HOUSTON 3 • DENVER 2
LOS ANGELES 21 • SAN FRANCISCO 7 • PORTLAND 9 • SEATTLE 4

Manhattan's New Rotary Hose and Built-in Coupling . . . are earning the Tool Pusher's Preference

RAY-MAN ROTARY HOSE

A new conception of rotary hose construction gives RAY-MAN the super-flexible qualities demonstrated by the loose, supple coils illustrated here. Tool pushers make up Ray-Man Rotary Hose to swivel and stand pipe easier and quicker than ever before. It's also easier to transport from hole to hole. The hose suffers less stress and damage—lasts longer.

TYPE E BUILT-IN COUPLING

The new, streamlined coupling on Ray-Man Rotary Hose also contributes greatly to easier handling and freedom from accident. It's a lighter weight, full-flow coupling with no projecting flanges. The "Lip-Lok" Pressure Sealing feature is a new safeguard against costly leaks and blow-outs.

Made in 5,000 lb. test pressure for Ray-Man Rotary Hose and 4,000 lb. test pressure for Paranite Brand.

SIX MAJOR IMPROVEMENTS IN CONSTRUCTION

. . . make this combination your best buy.

1. Is extremely flexible
2. Holds steady in the derrick—resists pulsation under pressure
3. Lasts longer because of balanced, engineered construction
4. Handles easier in moving from location to location with less likelihood of damage
5. Has G. O. P. Flexlastics tube for all methods of drilling, including drilling-in with oil or oil-base mud
6. Has new Built-In Coupling featuring "Lip-Lok" leakproof seal

Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

For Positive Performance

on every pumping job in the oil fields -

- Pipeline booster service
- Salvaging oil from pits
- Transferring oil or gas to and from storage
- Dewatering around the wells
- Water tank service
- General maintenance pumping

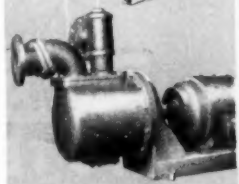
CARTER Humdinger PUMPS

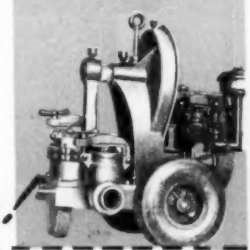
Name your pumping problem — and we'll show you the Humdinger designed specifically for that type of work . . . that will do it more efficiently — and more economically!

SELF-PRIMING CENTRIFUGALS — SINGLE & DOUBLE DIAPHRAGMS
Gasoline & Electric Powered—Capacities of 3000 GPH to 125,000 GPH

Here are some of the Plus Values in Humdingers that keep your upkeep down!

Patented ball-priming gives you split-second priming and re-priming . . . and insures maximum capacities. Nitraloy impeller is corrosion and abrasion resistant. Neoprene suction check valves and seal rings give positive sealing on oil, gas or water. Drop-forged engine shaft. Precision-machined pump case is cast of finest grain iron alloy. Co-axial volute and oversize pumping chamber—reduces heat, eliminates priming water loss.





Let us show you—right on your own job—how a Humdinger will deliver peak performance the way you want it. Every Humdinger is unconditionally guaranteed to equal or exceed performance specifications . . . and our 52-year record backs this guarantee!

Our Mid-West office—at 210 N. Main St., Tulsa, Okla., is ready to help you today—on any pumping problem—or write direct to main office.

FREE for you!

RALPH B. CARTER CO.
Humdinger PUMPS
196 ATLANTIC STREET
HACKENSACK, NEW JERSEY

RALPH B. CARTER COMPANY
196 Atlantic St., Hackensack, N. J..

SEND ME YOUR COMPLETE PUMP CATALOG.

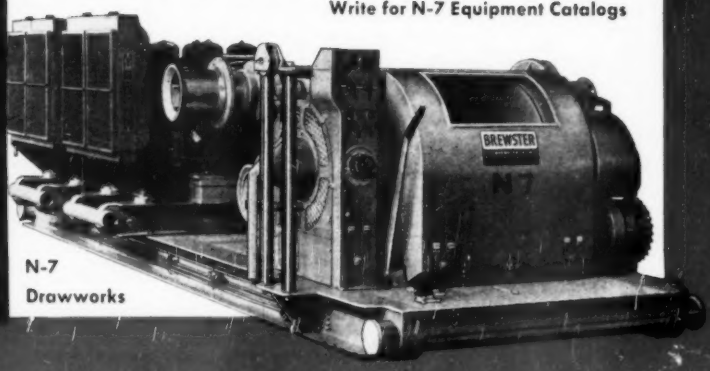
Name.....
Title.....
Company.....
Address.....
City.....Zone.....State.....

3 GREAT DRILLING TEAMS

BREWSTER N-7 TEAM

For 7500' DRILLING

Write for N-7 Equipment Catalogs



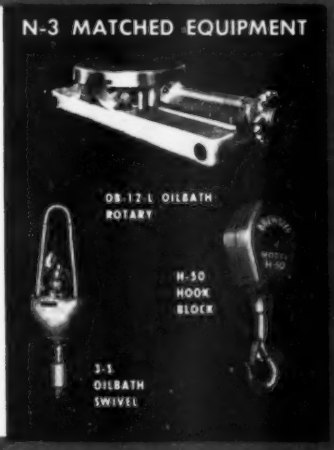
N-7 Drawworks

BREWSTER N-3 TEAM

For 3500' DRILLING

WRITE FOR N-3 EQUIPMENT CATALOGS

N-3 Drawworks



Brewster Equipment is Sold By

APEX EQUIPMENT CO.
BOVAIRD SUPPLY CO.
INDUSTRIAL SUPPLY CO.
MURRAY BROOKS, INC.
REAMS SUPPLY CO.

In Canada:

HALEY SUPPLY CO.

BY BREWSTER

BREWSTER
N-4 TEAM

For 5000' DRILLING

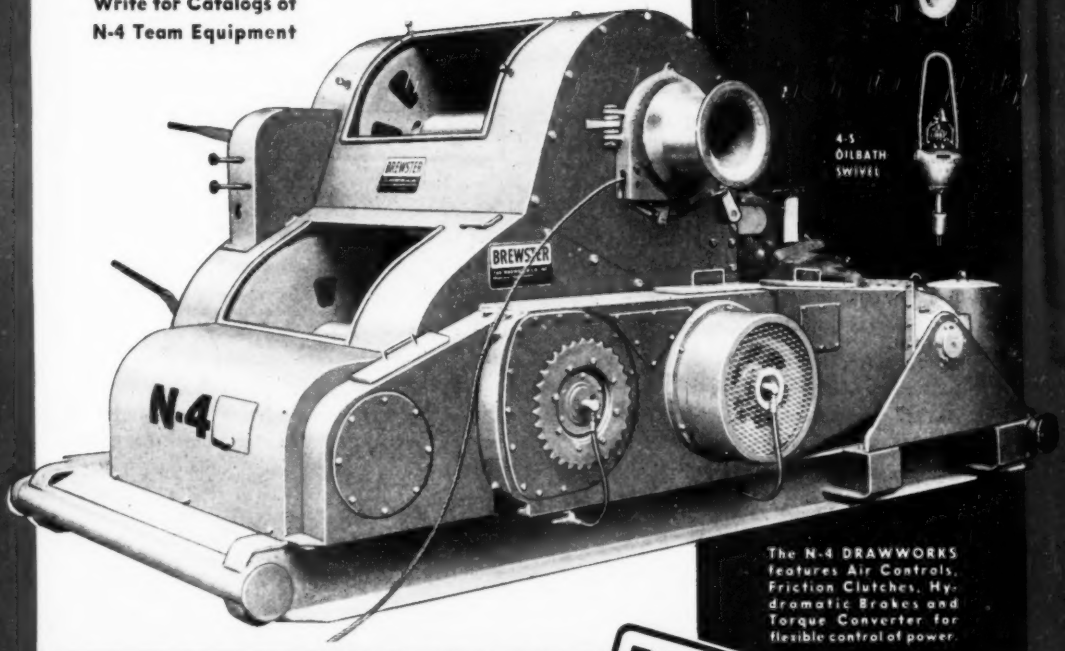
Write for Catalogs of
N-4 Team Equipment

N-4 MATCHED EQUIPMENT

RS-1B OILBATH ROTARY

H-100 HOOK BLOCK

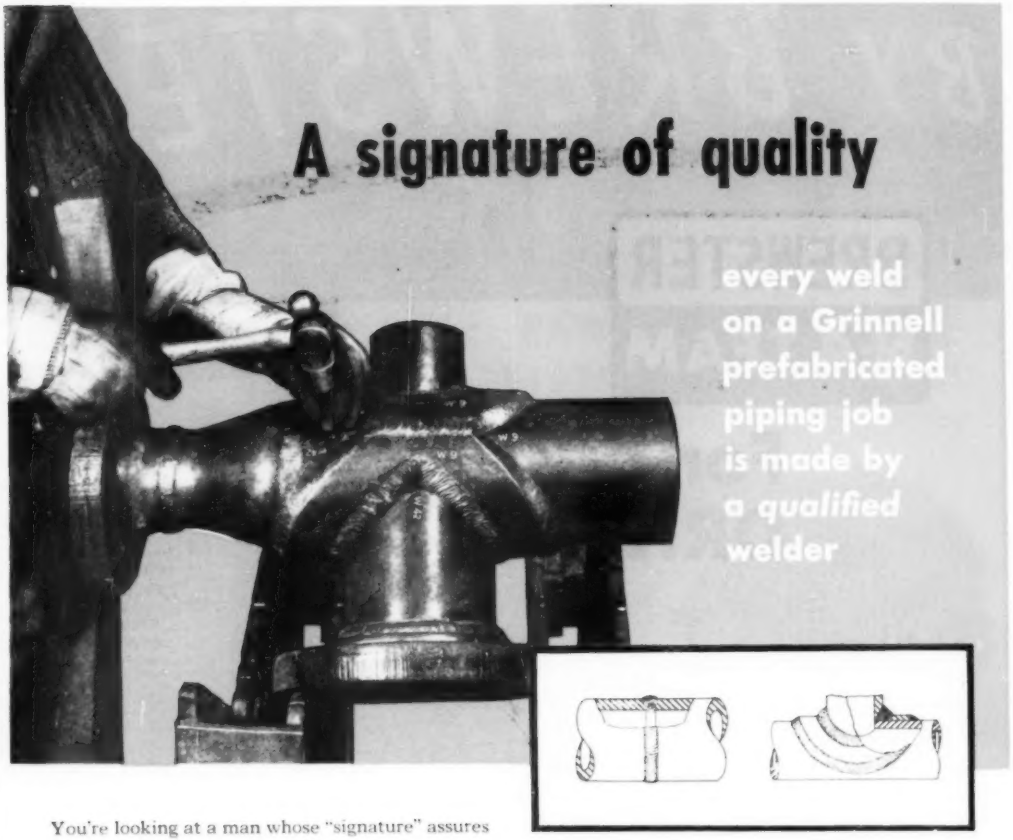
4-S OILBATH SWIVEL



The N-4 DRAWWORKS features Air Controls, Friction Clutches, Hydromatic Brakes and Torque Converter for flexible control of power.

The BREWSTER CO., Inc.
Manufacturers of Drilling Equipment Since 1918
SHREVEPORT, LOUISIANA, U.S.A.

BREWSTER
Drilling Equipment



You're looking at a man whose "signature" assures quality welding of piping. He's a Grinnell welder and, as every Grinnell welder, he is qualified by Grinnell according to a procedure which conforms to A.S.M.E. Boiler Construction Code, Section 9. After qualifying, he is given a number which he "signs" adjacent to each weld he makes.

Quality welding is only one of a long chain of responsibilities assumed by Grinnell on every prefabricated piping job . . . from the interpretive engineering to the on-time delivery of the fabricated piping. Such responsibility requires facilities for metallurgical research and testing, comprehensive knowledge of state laws and industry codes, and a complete familiarity with insurance company requirements for fabricated piping.

The fabrication of piping for today's high pressure, high temperature or corrosive services is a job for experts. It's a job for Grinnell prefabricating plants because Grinnell has the modern equipment and methods, and the skilled personnel which enable them to assume total responsibility for the job.

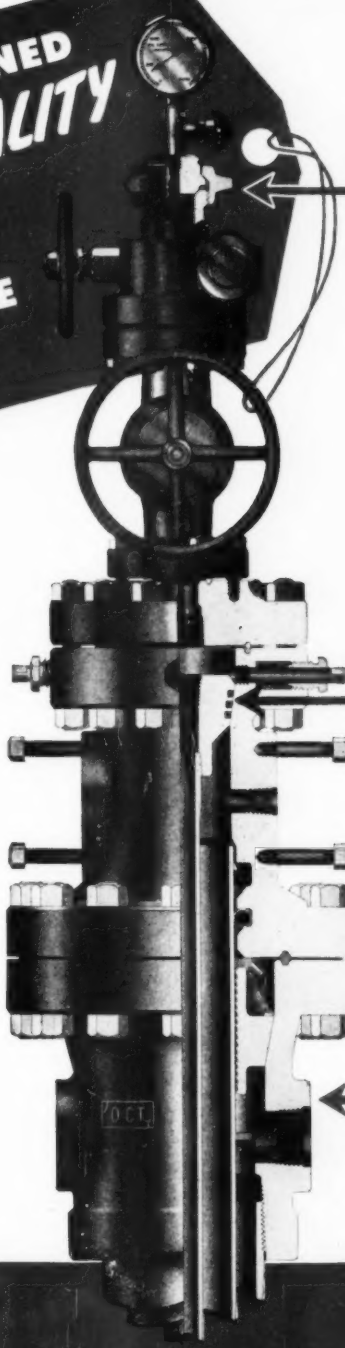
99 YEARS PIPING

GRINNELL

Grinnell Company, Inc., Providence, Rhode Island. Branches: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

O-C-T HAS COMBINED ECONOMY AND QUALITY IN THIS LOW PRESSURE ASSEMBLY

C-18-E SLIPS—Hinged for fast installation. May be dropped through preventers before cementing.



JE-1 FLOW CONTROL . . . four pieces in one—quick change wing valve.

T-16 THREADED HANGER (other interchangeable models available).

T-16 OU TUBING HEAD. Positive dual casing seal, no installation labor, reduced pressure area, low flange stress.

C-18-E SLIPS
Other interchangeable C-18 hangers available

C-18 CASING HEAD BODY.

For areas where pressure around the casing at time of setting is not a problem and oil strings are less than 8000 feet, this quality O-C-T Wellhead Assembly offers a low cost, efficient unit, quickly installed without numerous loose parts.

The C-18-E Slips are conveniently hinged for handling and have maximum load capacity consistent with their length. They can be dropped through preventers to provide casing support before removing preventers, if desired.

The O-C-T OU Seal is positive and automatic. Simply cut casing off at right length, bevel edge and install tubing head.

Write today for complete engineering details on this high quality low pressure wellhead assembly.

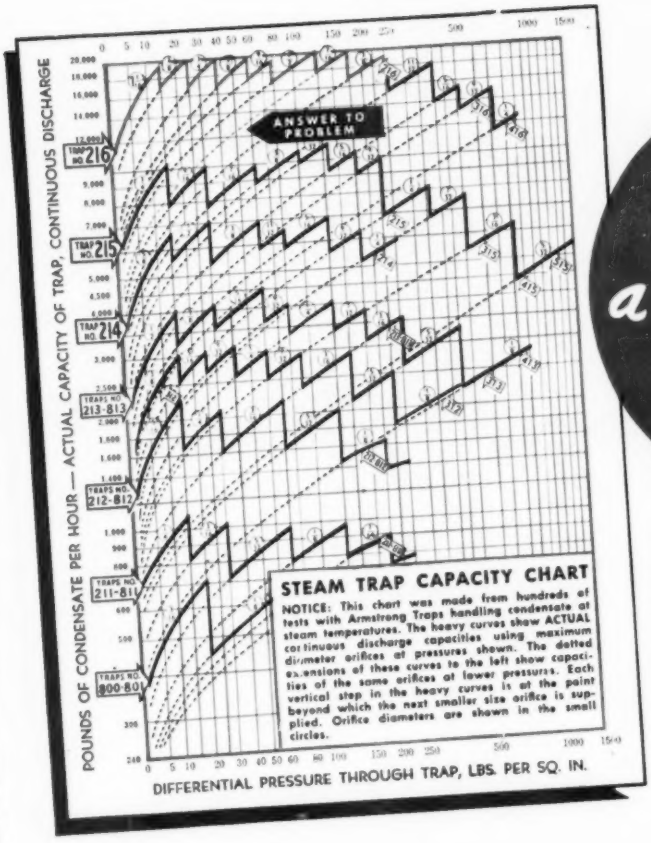
NOTE: FOR DEEP WELLS WITH HEAVY STRINGS AND HIGH PRESSURES AND WHERE A SEAL IS NEEDED BETWEEN STRINGS PRIOR TO REMOVING BLOWOUT PREVENTERS, OUR C-19 CASING HEAD IS RECOMMENDED.

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

Oil Center Tool Co.

P. O. Box 3091 • Houston, Texas

Export Representatives: Venezuela, Colombia, Peru, and Ecuador—Barry & Hall, Apartado No. 304, Maracaibo, Venezuela—Stirling Areas—La Grand, Smith & Gott, Ltd., Scotfoil, Aberdeen, England. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston 1, Texas.


ANSWER TO PROBLEM
TRAP NO. 216
TRAP NO. 215
TRAP NO. 214
TRAPS NO. 213-813
TRAPS NO. 212-812
TRAPS NO. 211-811
TRAPS NO. 900-810
POUNDS OF CONDENSATE PER HOUR — ACTUAL CAPACITY OF TRAP, CONTINUOUS DISCHARGE
DIFFERENTIAL PRESSURE THROUGH TRAP, LBS. PER SQ. IN.
STEAM TRAP CAPACITY CHART
NOTICE: This chart was made from hundreds of tests with Armstrong Traps handling condensate at steam temperatures. The heavy curves show ACTUAL continuous discharge capacities using maximum diameter orifices at pressures shown. The dotted extensions of these curves to the left show capacities of the same orifices at lower pressures. Each vertical step in the heavy curves is at the point beyond which the next smaller size orifice is supplied. Orifice diameters are shown in the small circles.

HOW TO SOLVE a Steam Trap PROBLEM:

BECAUSE good trapping starts with selection of the right trap for the job, Armstrong has provided all the data necessary for correct trap selection in the Armstrong Steam Trap Book. The Capacity Chart reproduced here is taken from this handy reference work. By means of this chart, any engineer can select the correct traps for his requirements. Here is a typical problem showing how the chart is used:

Given: An evaporator condensing 6000 lbs/hr at 50 psi when the steam is first turned on, but condensing only 1000 lbs/hr at 150 psi at the end of the process. Safety factor of 2 to 1 required at the *minimum* pressure differential.

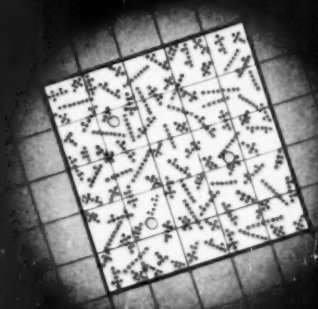
Solution: Referring to the chart, the No. 216 Armstrong Trap with 7/16" orifice for 150 psi pressure has a capacity of 12,000 lbs/hr at 50 psi. This provides for the 2 to 1 safety factor and is, therefore, the correct trap for the job.

The Armstrong Steam Trap Book provides recommended safety factors for different services and handy tables to help you calculate condensing rates. Other useful data included are: hook-up diagrams; do's and don't's; trouble-shooting tips; prices and specifications. You're welcome to a copy. **ARMSTRONG MACHINE WORKS, 868 Maple Street, Three Rivers, Michigan.**

ARMSTRONG *Inverted Bucket* **STEAM TRAPS**

For fuel savings, low maintenance, automatic air removal **SPECIFY ARMSTRONG!**

invisible . . . and . . . destructive



An ultra-ultra microscope might show the above view of an untreated gasoline. It would disclose the presence of those **THREE YELLOW MERCAPTAN MOLECULES.** It is an established fact that these mercaptans destroy the effectiveness of Tetra-ethyl lead. The Tannin-Solutizer process removes them and for the same Octane of the finished gasoline, T.E.L. requirements may be cut in-half.

Tannin Solutizer Process increases gasoline profits

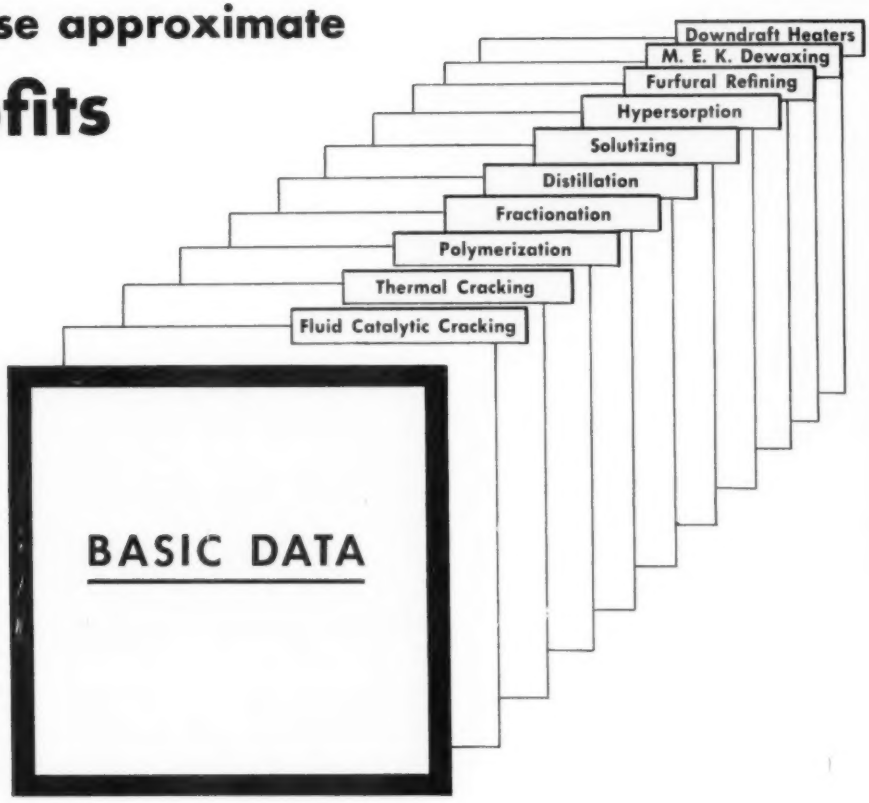
FOSTER WHEELER CORPORATION

165 BROADWAY NEW YORK 6 NEW YORK

"quickie estimates"

disclose approximate

profits



To refiners contemplating additional processing equipment we offer another Foster Wheeler service:—the "Quickie estimate."

This is made possible by completely correlated data on investment and operating costs of over 500 complete processing units —built by Foster Wheeler.

Your request for a "Quickie estimate" on any type and capacity of petroleum processing unit will receive prompt attention from our branch offices.

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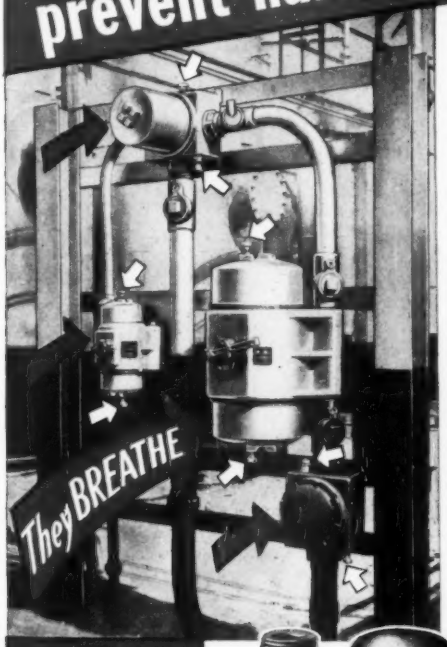
CROUSE-HINDS Breathers

prevent harmful water condensation

in explosion-proof electrical conduit systems

under humid conditions



- **FORESTALL** the formation of destructive mildew by ventilating enclosures.
- **EXTEND the LIFE** of insulation and equipment under adverse conditions.
- **MINIMIZE** the danger of expensive shut-downs due to insulation or equipment failure.

Paragraph 5015-C5 of the 1947 National Electrical Code states that *"where there is a possibility that water or other condensed vapor may be trapped at any point in the raceway system, approved means shall be provided to prevent accumulation, or to permit periodic draining of such water or condensed vapor"*

Explosion-proof electrical enclosures cannot be vented in any of the usual ways because they must be kept flame-tight. Crouse-Hinds' explosion-proof Type ECD Breathers, Type ECD Drains, and Type EZD Drain Sealing Condulets meet the Code requirements and are listed by Underwriters Laboratories for such service.

The Breathers are similar to the Drains but have metal hoods which make them water and dust shedding. Both have corrosion-resisting bodies with internal flame-tight (but not airtight or watertight) labyrinths. They can be used freely without impairing the explosion-proof integrity of a conduit system, providing they are always installed in a Condulet hub or other opening *with five or more full threads engaged.*

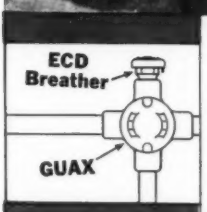
In humid atmospheres, water condensation occurs in explosion-proof systems, especially where temperature changes are frequent. Accumulation of water in harmful quantities is common. Mildew, a bacterial growth, is often present. It attacks many insulations and will destroy them unless the cause is removed. In such humid atmospheres troubles of this nature can be avoided by the proper installation of Crouse-Hinds' Breathers and Drains in conjunction with explosion-proof Condulets*.

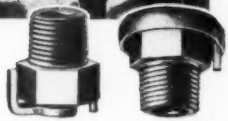
Breathers should be placed at the highest points and Drains at the lowest points of all housings and conduit runs. Heat generated by the current flowing through conductors and electrical devices raises the temperature of air within the conduit and housings. Breathers and Drains permit the resultant upward passage of the warmed air to remove moisture and thoroughly ventilate the enclosures. This prevents the accumulation of water and removes moisture that may have collected under unusual conditions.

This method is successfully used in many of the largest plants in the chemical and petroleum industries. Several years of field experience has demonstrated that the moisture is either entirely removed by ventilation, or so reduced that it is not harmful.

These devices have also been successfully used in non-hazardous locations where condensation is troublesome.

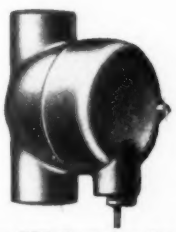
If you have a condensation problem, Crouse-Hinds Company will gladly assist in solving it. Write to





Type ECD Drain — Type ECD Breather

CONDULETS with Crouse-Hinds Breathers and Drains can be installed for ventilation throughout an entire explosion-proof conduit system



Type EZD Explosion-Proof Drain Sealing Condulet

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Washington. *Resident Representatives:* Albany — Atlanta — Baltimore — Charlotte — New Orleans — Richmond, Va. CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

* *CONDULETS are made only by CROUSE-HINDS*

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PROOF - *not Guesswork*

Makes FWD America's Foremost Heavy-Duty Truck

Here's actual operating proof in oil field service. This FWD six wheeler — doing an everyday job — is going cross-country through mud and clay to deliver equipment. Yes — power and dependability needed for tough jobs like this are built into every FWD Four or Six Wheel Drive Truck. You can be sure of this even before you buy, because FWDs are scientifically tested on FWD's proving ground to plow through mud and clay that reach over the bumper. *No wonder many of the world's leading oil field operators standardize on FWDs—with individual fleets of over 600 units.*

WHAT FWDs DO ON THE PROVING GROUND
1 Highball over hilly curved roads!
2 Slog thru mud — up to the bumper!
3 Speed over 100 ft. unbanked circle!
4 Twist over ditches — 18 inches deep!
5 Drive up 6% grade thru 3-ft. of sand!
6 Climb 70% grade from dead stop!
7 Climb 8-in. beam from standstill!
8 Drill pole holes to prove equipment!
9 Speed safely over level highways!
1
2
3
5
6
7
8
9

This is FWD's proving ground. This is your assurance that the FWD you select has the stamina to insure long life without expensive mechanical breakdowns.

An FWD slogs through the "mud hole" at the proving ground. For all the facts, see your FWD distributor — or write FWD direct.

An Invitation To Truck Buyers

We invite you to watch FWDs pass a series of rigid performance tests. Ask your FWD distributor to arrange your visit to our plant. Or — if you can't get away, ask him to show you the movie, *The FWD Story*. In either case, you will see for yourself how FWD trucks can help solve your heavy-duty trucking problems.

Walter G. Olson
President
The Four Wheel Drive Auto Company

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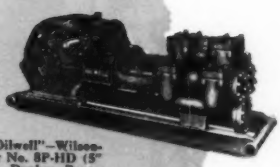
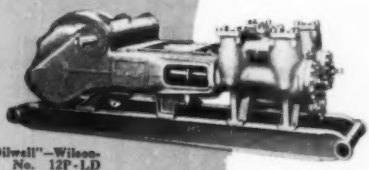
Clintonville, Wis. • *Canadian Factory:* Kitchener, Ontario
FOUR AND SIX WHEEL DRIVE TRUCKS

America's Foremost Heavy-Duty Truck

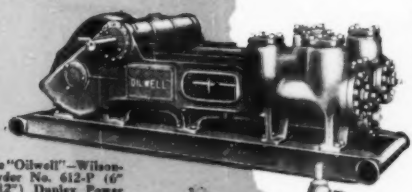
5 *dependable* PUMPS for portable rigs



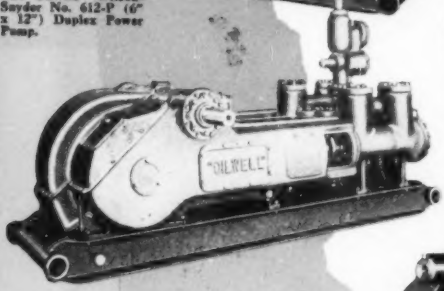
The "Oilwell"—Wilson-Snyder No. 8P-HD (5" x 8") Duplex Power Pump.



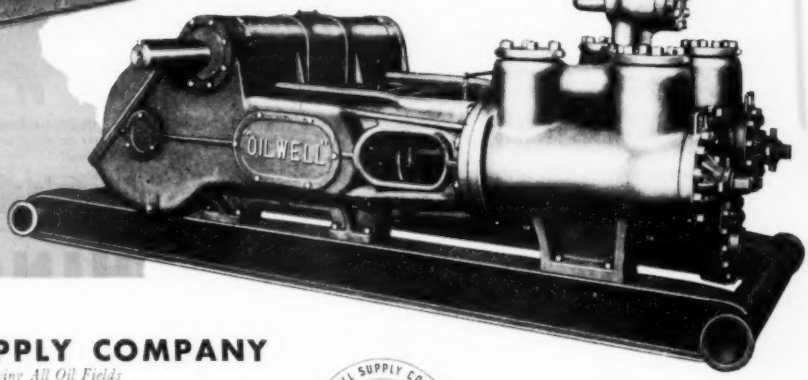
The "Oilwell"—Wilson-Snyder No. 12P-LD (6" x 12") Duplex Power Pump.



The "Oilwell"—Wilson-Snyder No. 612-P (6" x 12") Duplex Power Pump.



The "Oilwell"—Wilson-Snyder No. 712-P (7¼" x 12") Duplex Power Pump.



The "Oilwell"—Wilson-Snyder No. 14P-HD (7¼" x 14") Duplex Power Pump.

THERE is an "Oilwell"—Wilson-Snyder Duplex Power Pump of the right size and capacity for every drilling requirement. The 5 pumps illustrated are recommended for portable rigs where the drilling depths are moderate.

Outstanding advantages of these pumps include: (1) single helical gears which are reversible to compensate for wear, (2) crankshaft and pinion shaft are made of heat-treated alloy steel and mounted in adjustable tapered roller bearings, (3) large streamlined passages assure minimum restriction to mud flow and adequately large valves are provided for high speed operation, (4) bearings, pinion, main gear, and crossheads are lubricated by a combination oilbath and positive flow lubrication system, (5) crosshead-pin roller bearings, diaphragm stuffing boxes, and fluid-end stuffing boxes are pressure grease-lubricated, (6) DI-HARD fluid cylinder liners, (7) HI-HARD piston rods having A.P.I. taper, (8) alloy steel fluid valves and seats, (9) flexible mud-baffle discs, (10) all pumps are equipped with packed-off liners and (11) all pumps are mounted on a heavy-duty steel skid assembly.

A complete line of Accessories including suction strainers, valves, working tools and types of packing is available.

BRIEF SPECIFICATIONS

Pump	Max. Liner Size by Stroke	Hydrostatic Test Press. —Discharge p.s.i.	Working Press. With Full-size Liners p.s.i.	Recom. Speed r.p.m.	Theoretical Displacement at Max. R.P.M. g.p.m.	Rec. Brake H.P. Input
8P-HD	5" x 8"	3000	600	80	205	85
12P-LD	6" x 12"	2000	365	70	395	100
612-P	6" x 12"	3000	520	70	390	140
712-P	7¼" x 12"	3000	550	70	580	220
14P-HD	7¼" x 14"	4000	765	65	620	325

OIL WELL SUPPLY COMPANY

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UNITED STATES STEEL

OIL WELL SUPPLY COMPANY · USS OILWELL · UNITED STATES STEEL

Ask your nearest "Oilwell" representative for "Oilwell" Wilson-Snyder Power Pump Booklet No. 6C-1047.

"OILWELL"

FIRST...

FOR SECONDARY RECOVERY!

There's nothing like a Worthington Variflo for water flooding

Back in the days of oil field pioneering Worthington found that *constant* water pressure was needed to displace recoverable oil — and that any reduction of pressure meant loss of production. Because the ordinary pumps used for this service were also doing other water-pumping jobs, pressure was constantly fluctuating — and recoverable oil was being lost.

Worthington Found The Answer in Variflo Triplex Pumps. Providing constant pressure at all times, Variflos automatically vary their capacities to compensate for water withdrawn *for any other purpose.*

Operating on any standard air-type pressure controller, Worthington Variflo Pumps bring stepless, automatic variation — *from zero to 100%.* Except for the variable capacity feature, Worthington VTE Pumps offer the same advantages in constant capacity design.

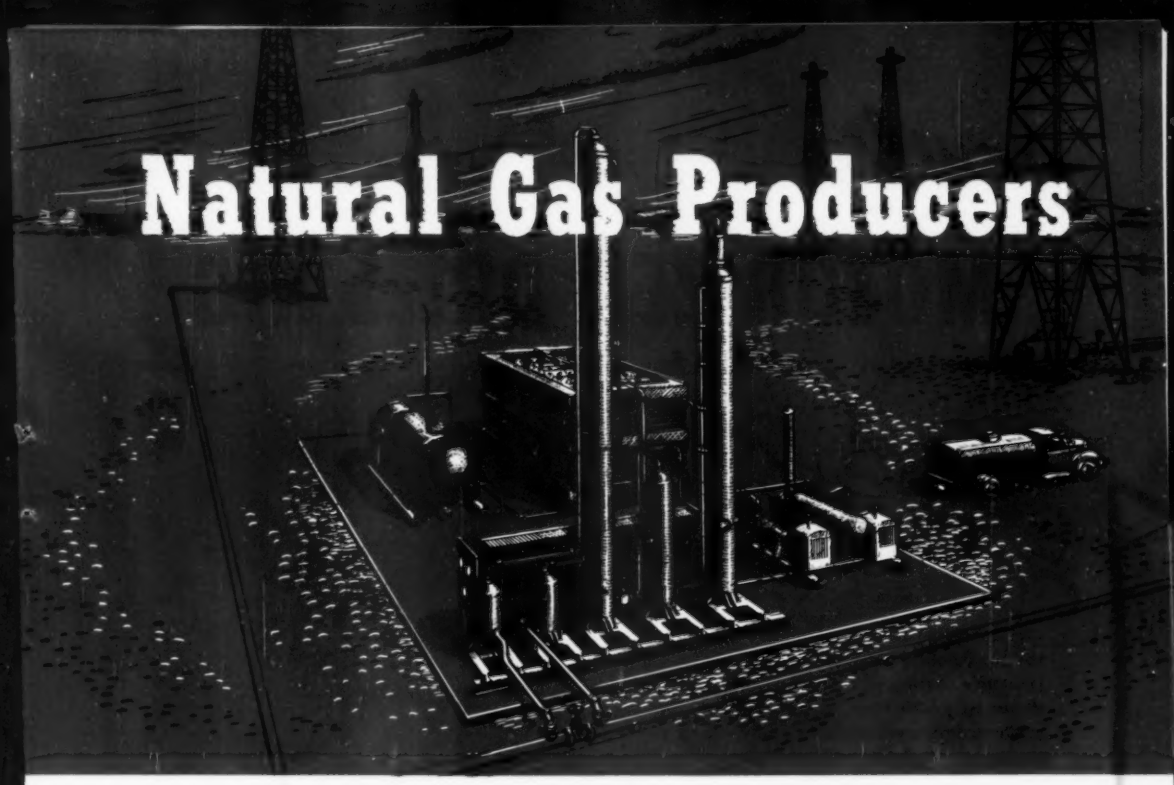
Exclusive Features make Variflos and VTE's the most efficient money-savers in many other oil field applications. For further facts proving *there's more worth in Worthington,* write to *Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, New Jersey.*

A 2x4 Worthington Variflo Triplex Pump used in secondary recovery (water flooding) of oil from the ground.

WORTHINGTON

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

Natural Gas Producers



THIS PLANT WILL SAVE YOU MONEY

It is a compact, flexible, automatically controlled gasoline absorption and stripping plant designed to eliminate the need for steam and electric power. You can install it on small and remote leases where a limited water supply is available for make-up.

This plant is easily installed and is economical in operation and maintenance. Waste gas is used for process fuel, gas engine and instrument operations. A single operator can supervise a number of small plants or attend to other duties. The complete plant may be readily and easily dismantled and reassembled at another site. The cost of the plant is quickly amortized by the recovery of salable raw gasoline. The addition of fractionating equipment for recovery of higher priced stabilized gasoline and liquefied petroleum gases will insure a reasonable amortization period under varying market conditions. Ask for Bulletin 2225.

Throughout the process industries, Blaw-Knox engineering and construction facilities are being employed to increase production and build greater profits in a rapidly tightening market.

CHEMICAL PLANTS
Division of BLAW-KNOX CONSTRUCTION CO.
321 PENN AVE.
PITTSBURGH 22, PA.

BLAW-KNOX

NEW! The JOY #150 MOTORIZED DRILL RIG

Latest in Design First in Performance

JOY'S new #150 Motorized Drill Rig is designed for heavy-duty seismograph, electrical logging, structure testing and shallow water well drilling down to 1500 feet. It incorporates the most modern improvements in drill rig design—has proved itself outstanding in the field within its capacity range. Note these exclusive features:

- ★ **All chains are oil-bath lubricated and run in oil-tight cases.**
- ★ **Equipped with conventional oil-bath rotary table with 6⅜" opening. For running larger casing, the rotary table is retractable 14 inches.**
- ★ **Mast elevating and lowering cylinders are arranged to eliminate over-travel on either the up or down stroke.**
- ★ **Main drum clutch and sand-reel clutch use same friction plates.**

WRITE FOR BULLETIN

The efficient and highly portable #150 Motorized Drill Rig on the job.

W&D 02195

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

Strategically located in every oil producing area, Tretolite service engineers are always available to assure you of efficient service, prompt deliveries and maximum dehydrating effectiveness.

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VICE FOR EVERY FIELD

TRETOLITE COMPANY

Manufacturing Chemists

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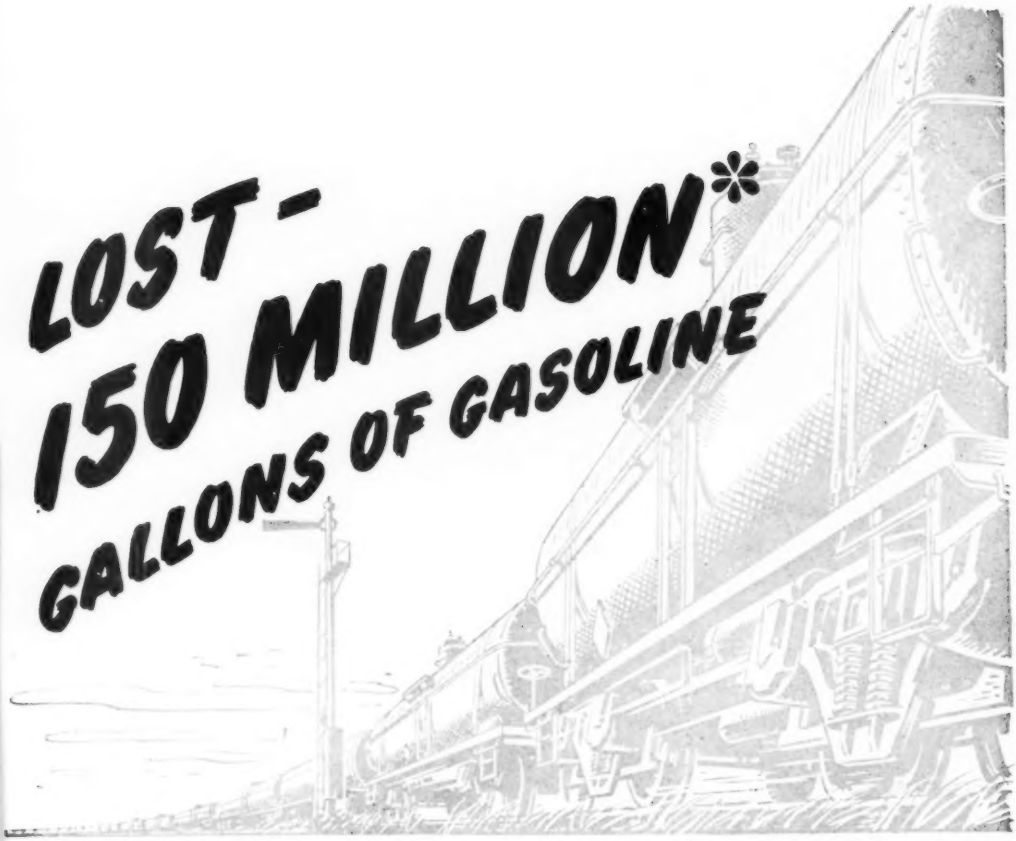
DEHYDRATING | DESALTING

LOST - 150 MILLION* GALLONS OF GASOLINE



ENOUGH gasoline is lost by evaporation each year in this country to fill a tank car train 150 miles long. Much of this waste could be avoided through the use of Graver conservation equipment.

First and foremost in the battle for conservation is the Graver Expansion Roof Tank. It *ends evaporation losses* . . . provides protection of multiple tank installations through manifolding . . . maintains quality throughout the storage period. It also adds the advantages of *safety* — reduced fire hazard . . . *simplicity* — no maintenance problem . . . and *permanence* — no parts to wear.

With every one, from Congress to consumer, worried over dwindling oil reserves and so much gasoline vanishing into thin air, it's time to talk it over with Graver. Ask Graver engineers to analyze your storage problems and show you how the Expansion Roof stops vapor losses.

*Estimated

GRAVER

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

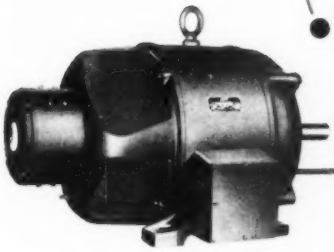
EAST CHICAGO, INDIANA

NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

The "High Slip" of Century Type SCT MOTORS

Century 5 HP splashproof Type SCT squirrel cage motor driving an oil well pumping rig.

- **Saves Wear and Tear on Equipment**
- **Keeps Pumping Units Operating**



Century Alternating Current Generator with direct connected exciter and drip proof covers.

Century Generators

Where public service current is not available, Century Generators will provide adequate, continuous electric power. Depending on the load per motor and the size of generator, from 10 to 30 wells can be operated from one generator. They provide a dependable source of oil field power.

CENTURY Type SCT squirrel cage pumping unit motors provide high torque combined with high slip. Their high slip permits the motor to slow down as the load comes on, cushioning the impact of the peak load. This action reduces the sudden shock to both motor and equipment, saves wear and tear, reduces maintenance costs and keeps pumps operating.

SPLASHPROOF DESIGN PROTECTS AGAINST WEATHER. Century splashproof motors are scientifically constructed to resist the hazards of rain, sleet, hail and snow. Century splashproof motors assure dependable power regardless of the weather. Dripping or splashing liquids, or falling solids cannot get into the vital parts of the motor.

Century builds a wide range of oil field motors for oil producing, refining and distributing. Specify Century for all your electric power requirements.

See your nearest supply store for complete information.

Century C MOTORS

639

CENTURY ELECTRIC COMPANY
1806 Pine St., St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

The jet gun that hunts for oil

OIL field men have borrowed an idea from the tank-destroying "bazooka" gun of World War II to vastly increase the flow of oil from underground reservoirs.

A piece of steel tubing about seven feet long and perforated with 24 ports is lowered into the well. The ports are sealed, and behind each seal is a special conical high-explosive charge which, when detonated electrically, fires a jet of high-speed, fast-burning gases, just like the warhead of a "bazooka". This is powerful enough to punch through steel pipe and cement, deep into the surrounding strata, forming a funnel for the gushing oil.

To make this jet gun possible, a steel had to be found that would not split or rupture, and would bulge a minimum amount under the shock of explosive pressures much greater than those in the breech of an artillery gun.

Testing a wide variety of steels, oil tool manufacturers found the answer in Timken fine alloy seamless tubing. Hardened to exactly the right degree, it resisted rupture and bulging after repeated firings better than materials previously used. Today, leading users of perforating guns use Timken tubing for the job.

Here is yet another example of an unusual problem in industry that has now been stamped "Solved—by Timken Alloy Steel". No other alloy steel producer can equal this record of tough steel problems solved. Why not let us go to work on *your* steel problems today? Write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN
Fine Alloy
STEEL
and Seamless Tubes

TIMKEN
1899 50 1949

50th birthday of the company whose products you know by the trade-mark: TIMKEN

COPR. 1949 THE TIMKEN ROLLER BEARING COMPANY

HERE'S WHAT THEY SAY ABOUT BUCYRUS-ERIE SPUDDERS . . .

'Handles everything easier'

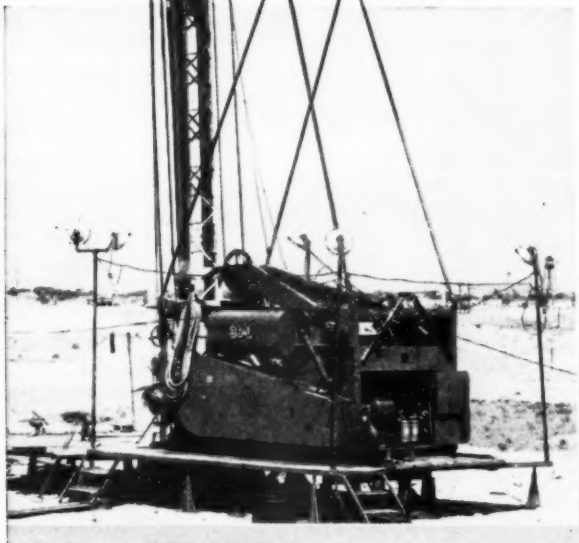
'Saves time in moving and rigging up'

'Best I've ever had for handling pipe'

'Never saw a machine operate so smoothly and quietly'

'On swabbing, brings out a load of oil in high gear'

'I've never seen anything handle tools so well at such depths'



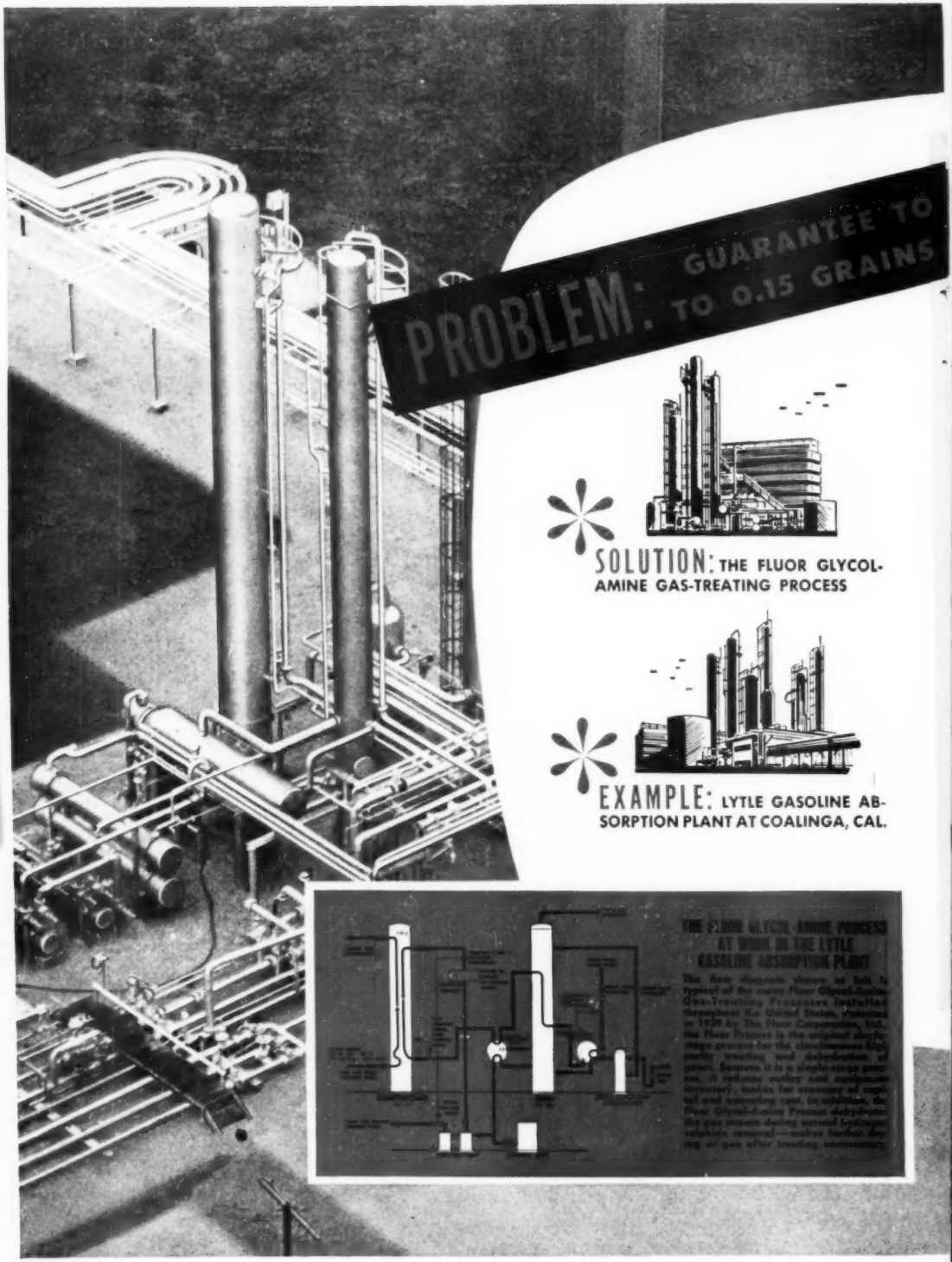
These actual words, spoken about Bucyrus-Erie spudders by experienced, successful oil well contractors, tell just a few of the many reasons why Bucyrus-Erie spudders have proved their superiority in oilfields everywhere. Investigate the Bucyrus-Erie line of spudders and learn about the many features that are paying off in profits for hundreds of owners. Bucyrus-Erie Company, South Milwaukee, Wis.

43548

There's a Bucyrus-Erie spudder for each of these ranges

	Top-to-bottom drilling	Servicing
24-L	1500 ft.	2000 ft.
28-L	2500 ft.	3000 ft.
36-L	3500 ft.	4000 ft.
48-L	6000 ft.	7000 ft.

See Your BUCYRUS ERIE Spudder Distributor


PROBLEM: GUARANTEE TO TO 0.15 GRAINS
SOLUTION: THE FLUOR GLYCOL-AMINE GAS-TREATING PROCESS
EXAMPLE: LYTLE GASOLINE ABSORPTION PLANT AT COALINGA, CAL.
THE FLUOR GLYCOL-AMINE PROCESS AT WORK IN THE LYTLE GASOLINE ABSORPTION PLANT

The Lytle Gasoline Absorption Plant at Coalinga, California, is a story of the Fluor Glycol-Amine Gas-Treating Process at work.

Expansion of natural gas supply through deeper drilling introduced into the Lytle Plant a natural gas so high in hydrogen sulphide content that it was no longer acceptable as commercial sales gas. After processing for gasoline recovery, the discharge gas was analyzed and found to contain 1.25 grains of hydrogen sulphide per 100 SCF and up to three-fourths of 1 mol per cent of carbon dioxide. Even though this gas was sufficiently pure for sale in many areas, in this particular instance requirements for commercial gas were set to *not more than 0.15 grains of hydrogen sulphide per 100 SCF*... a purity requirement so stringent that it would only be attempted by Fluor Gas Processing Engineers using the Fluor Glycol-Amine Gas-Treating Process.

Following study of the requirement by Fluor, a Research Department pilot plant was set to run at gas composition and operating conditions simulating those at the Lytle Plant. Here it was *proved* the Fluor Glycol-Amine Gas-Treating Process could meet—*and exceed by a comfortable operating margin*—the 0.15 grain per 100 SCF requirement efficiently, economically, and on a guaranteed basis.

The plant for the Lytle job was then designed on the findings of the Fluor Research Department. Engineering was set in motion, and a field construction schedule formulated.

The Lytle unit is a "sweet"-running unit paralleling laboratory and pilot plant findings—meeting its guaranteed performance with an adequate margin. This new installation raises the total installed capacity of Fluor Glycol-Amine Gas-Treating Plants to 585,000,000 SCF/D.

Fluor invites owners and operators of gas-producing properties to submit their gas-treating problems for study and recommendation by Fluor's Gas Processing and Research Engineers. Let them study *your* particular problem—the range of purity obtained through use of the Fluor Glycol-Amine Gas-Treating Process is virtually unlimited. It may be the low-cost answer to your gas-treating problem.

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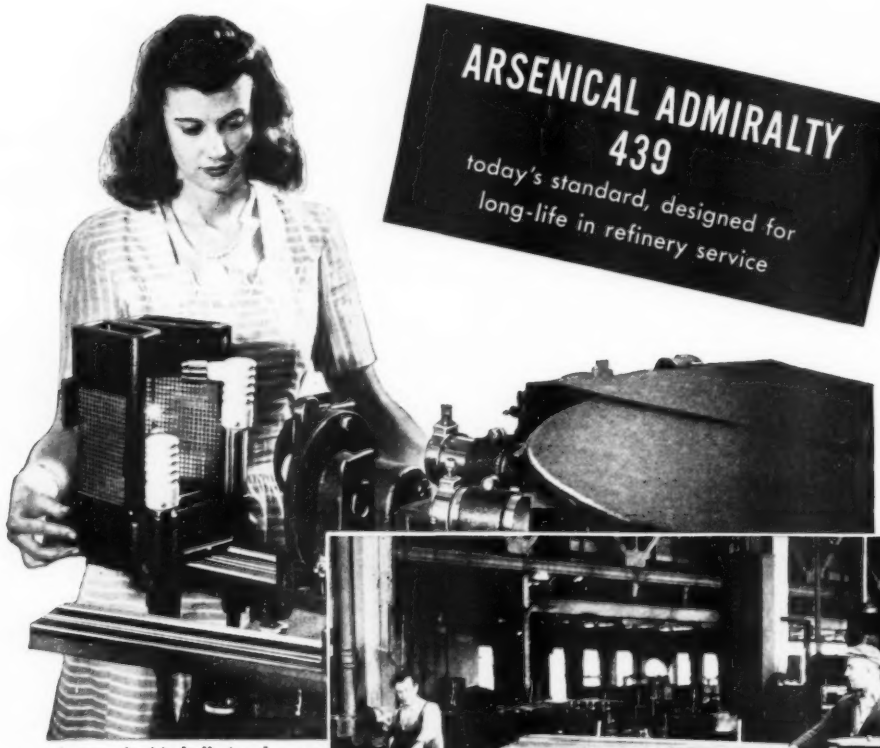
ARSENICAL ADMIRALTY 439

today's standard, designed for long-life in refinery service



Amount of critical alloying elements is checked in the laboratory with the help of this grating-type spectograph.

Every Anaconda Condenser Tube must withstand the hydrostatic pressure test required by A.S.T.M. Specification B 111.

CONTAINING approximately 70% copper, 28.96% zinc, 1% tin and 0.04% arsenic, Arsenical Admiralty 439 is highly resistant to dezincification, general corrosion, attack by fresh, brackish or salt waters, sweet or sour crudes under pressures, velocities and temperatures normally encountered in refinery condensers and heat exchangers.

Several years of extensive research preceded the commercial production of Arsenical Admiralty Tubes which was begun in 1934. The consistently satisfactory performance of Arsenical Admiralty Tubes in crude and re-run stills, cracking and polymerization plants for the past 15 years has fully proved the effectiveness of arsenic as an inhibitor of dezincification and has fully substantiated laboratory test results.

TECHNICAL SERVICE AVAILABLE

It is a function of the engineers of our Technical Department to assist tube users in the selection of the most economical alloy for any given set of operating conditions. Feel free to call on us. Publication B-2, giving detailed information on Tubes and Tube Sheet Alloys mailed on request. 48141

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Anaconda

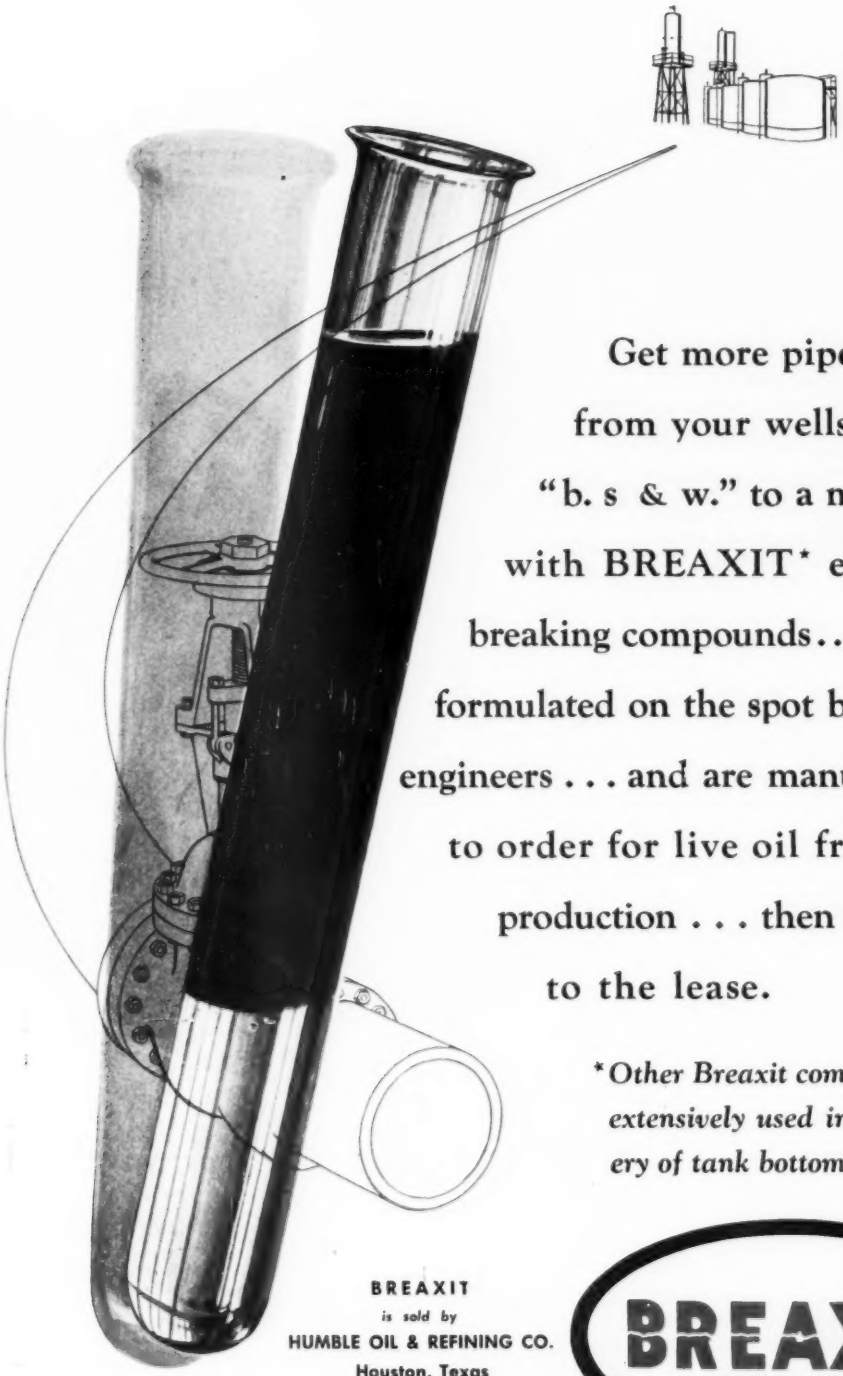
HEAT EXCHANGER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*



Get more pipe line oil from your wells . . . Cut "b. s & w." to a minimum with BREAXIT* emulsion breaking compounds . . . they are formulated on the spot by trained engineers . . . and are manufactured to order for live oil from your production . . . then delivered to the lease.

BREAXIT* *Other Breaxit compounds are extensively used in the recovery of tank bottoms.*

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designed for today's drilling

Designed for today's modern drilling methods—high speed and heavy weights—the CP Type EM three cone rock bit is setting new records in drilling medium hard rock formations—including lime rock, dolomite, hard shale, and anhydrite, found in oil fields throughout the world.

To withstand hard, abrasive wear and provide the long service required in modern drilling, cones and bearing journals are of high alloy forged steels, accurately machined and carefully heat-treated, with special hard-facing of the teeth on the cones.

CP bits are designed in various types and sizes to meet the specific drilling requirements in different oil fields.

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Schlieren photograph of shock waves in supersonic air stream.

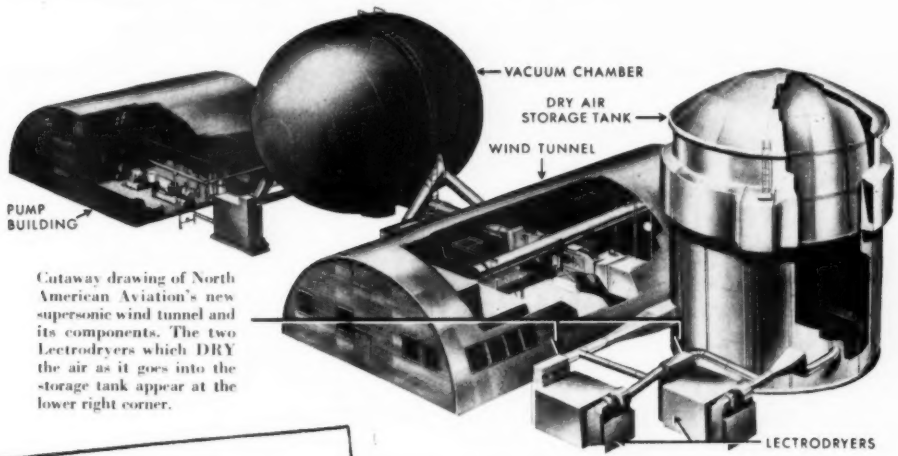
Moisture would upset flow lines and form fog, spoiling visibility

Over 4,000 miles per hour! Testing for such a speed is possible in the wind tunnel recently completed at Los Angeles as part of North American Aviation's progressive research policy. Air is *drawn* through the test section by sudden release of a vacuum, developing supersonic speeds for a 15 to 20 second period.

That air must be DRY. Otherwise, moisture condenses at the low temperatures reached in the test section. Fog forms and blinds the observer. Moisture causes a condensation shock, setting up erroneous forces. Two Lectrodryers, working in series as a team, do that DRYing. Dewpoints of −42° F. are obtained.

Lectrodryers are performing similar service in dozens of industries, in hundreds of plants all over the world; DRYing air, gases and organic liquids—handling minute or tremendous volumes—at atmospheric pressure or up to 3,000 psi.

Bulletin 216 shows you these Lectrodryers at work. For a copy, or for help on your DRYing problems, get in touch with Pittsburgh Lectrodryer Corporation, 325 32nd Street, Pittsburgh 30, Pennsylvania.



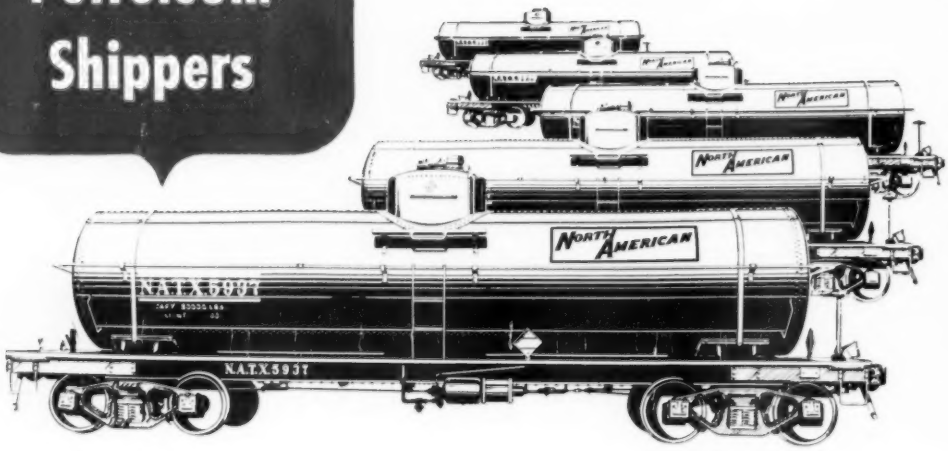
Cutaway drawing of North American Aviation's new supersonic wind tunnel and its components. The two Lectrodryers which DRY the air as it goes into the storage tank appear at the lower right corner.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U.S. PAT. OFF.

Product-Wise SERVICE for Petroleum Shippers



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Duplex Slush Pump

HP-8000-A WITH CAST STEEL FLUID END
HP-8000 WITH SEMI-STEEL FLUID END
7" x 12"

Sectional view showing construction of THE BIGGEST LITTLE PUMP ON THE MARKET!

- **NEW SPIRAL GEARS**
  Free from vibration, runs like a whisper. Takes less Power.
- **STEEL FLUID END**
  Can be field welded. Greater Strength, less weight.
- **EXCLUSIVE TIE ROD CONSTRUCTION**
  Rugged strength, minimum weight, maximum accessibility.
- **PERFORMANCE AND DEPENDABILITY**
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THE CITY NATIONAL BANK

OF HOUSTON

Condensed Statement of Condition As of the Close of Business June 30, 1949

RESOURCES

Cash and Due from Banks	$58,758,669.01	
U. S. Government Bonds	55,082,458.73	
Municipal Bonds & Warrants	1,188,220.44	
Federal Reserve Bank Stock	300,000.00	
Other Investments	800,000.00	$116,129,348.18
Loans and Discounts	42,620,964.85	
Commodity Loans Secured by Warehouse Receipts	1,267,852.97	43,888,817.82
Bank Premises	4,000,000.00	
Furniture and Fixtures	1.00	4,000,001.00
Interest on Securities and Other Income Earned—Not Collected		251,985.39
Customers' Liability on Letters of Credit		4,451,482.26
TOTAL RESOURCES		$168,721,634.65

LIABILITIES

Common Stocks	$5,000,000.00	
Surplus	5,000,000.00	
Undivided Profits	1,494,801.30	
TOTAL CAPITAL ACCOUNT		$ 11,494,801.30
Reserve Accounts		537,162.27
Liability on Letters of Credit		4,451,482.26
DEPOSITS:		
Individual	$120,205,173.24	
Banks	31,253,411.18	
Government	779,604.40	152,238,188.82
TOTAL LIABILITIES		$168,721,634.65

CAPITAL & SURPLUS $10,000,000.00

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W. J. KEITT
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W. C. MENASCO
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DAVID MAHOOD
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FRANK C. GUTHRIE
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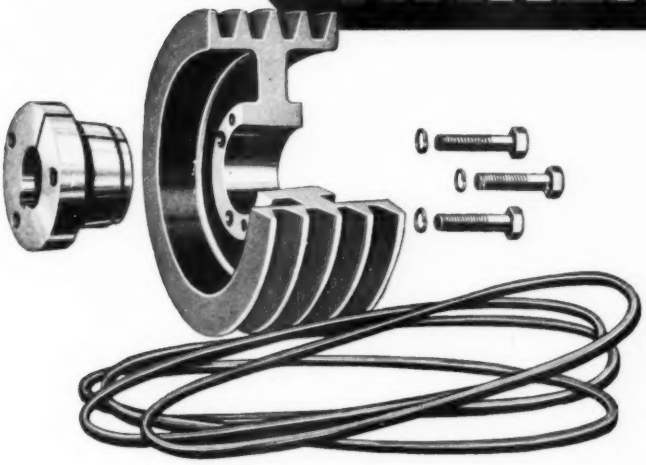

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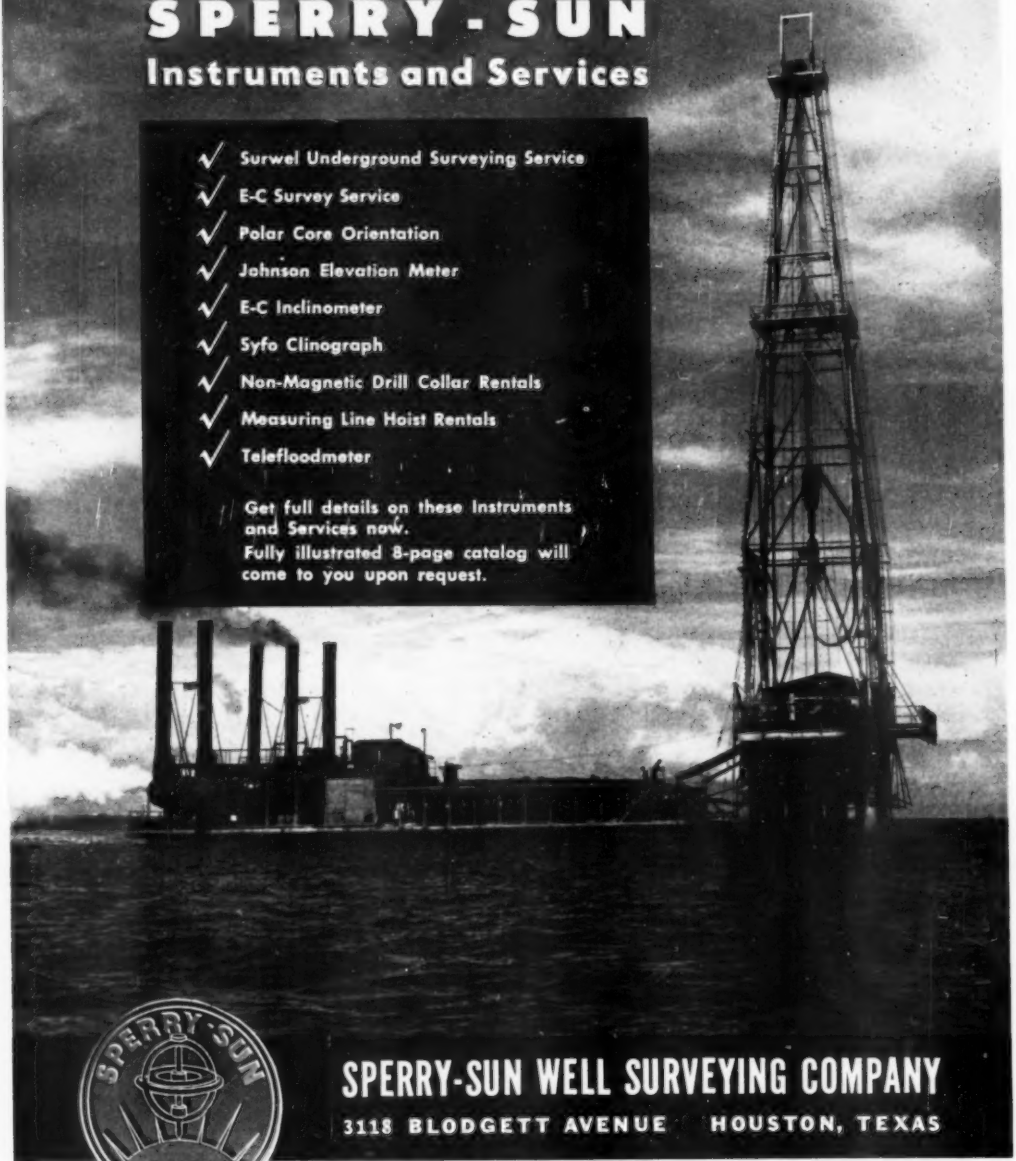

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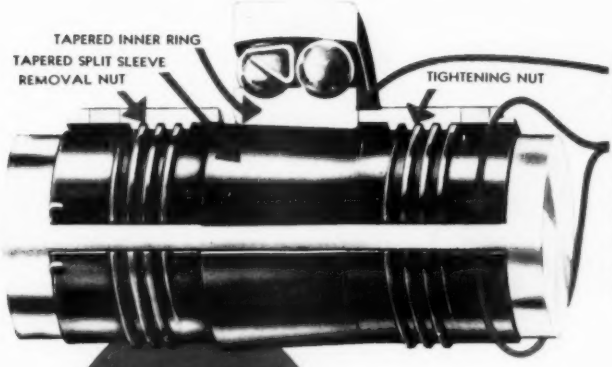
SOMETHING NEW!

SKF introduces the SUA UNIT PILLOW BLOCK featuring a tight fit between bearing and shaft

Here's How It Works



TIGHT FIT results when the tightening nut pushes the tapered inner ring over the tapered split sleeve.

CONCENTRIC GRIP is firm and positive—as the split sleeve contracts and wraps around the shaft. Removal is accomplished by reversing the process—with tightening nut loosened, removal nut pushes inner ring off the sleeve.

ON or OFF *in a few seconds*

The *new* SKF SUA Unit Pillow Block is completely assembled, lubricated and ready for immediate use. Available in "free" or "held" types and in shaft sizes from $1^{7}/_{16}$" to $2^{7}/_{16}$".

Its SKF-exclusive Align-O-Seals prevent lubricant leakage and dirt intrusion. Designated as type SUA with ball bearings—and type SUAR with spherical roller bearings.

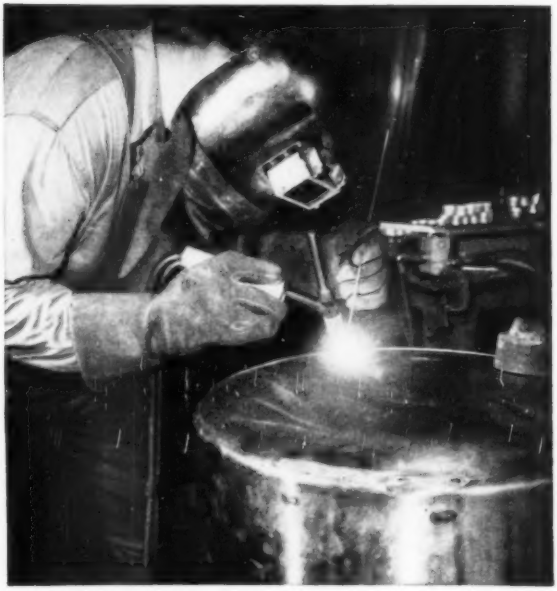
No exposed bearing . . . no lock screws to raise troublesome burrs on the shaft . . . the nut is locked to the sleeve . . . and even though the shaft vibrates, the concentric grip will not loosen.

For more information, check your local authorized SKF Distributor, or write: SKF Industries, Inc., Philadelphia 32, Pa. 6681

Bearings and pillow blocks engineered by SKF

Use Stainless Steel and HELIARC Welding

Trade-Mark



"Heliarc" welding a stainless steel water tank for use in railroad passenger coach. Welds will need no further finishing.

Switch to this Combination and Save Money

Build Sales Appeal with Stainless Steel

Get Clean, Fast Welding

Cut Finishing Costs to the Bone

Switch to the "Heliarc" process for welding stainless steel. Welding is fast, distortion is low, and there is no spatter with the "Heliarc" process. No flux is used and you save cleaning costs. The welds are so smooth that many articles need no grinding or finishing at all.

Switch to stainless steel for your other products too. They will have added strength, longer life, freedom from corrosion and better appearance. You build sales appeal into your product when you weld stainless steel with "Heliarc" equipment.

Get your free copy of the 24 page booklet, "Heliarc Welding" that tells about this clean, fast, worry-free process. Just fill out the coupon and we'll send your copy of the booklet without obligation.

The word "Heliarc" is a registered trade-mark of The Linde Air Products Company

Get your copy NOW!

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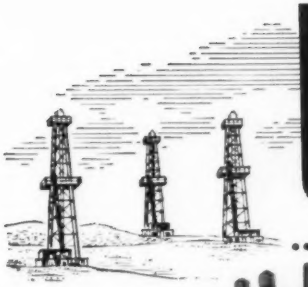

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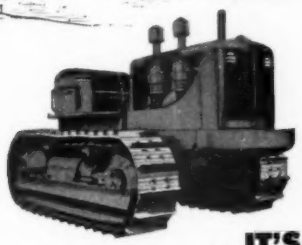
...IT'S AC TRACK-TYPE TRACTORS

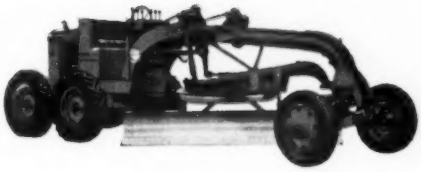


for bulldozer, scraper and winch work; any heavy pulling, pushing or lifting. Four sizes, 11,000 to 40,000 lbs. . . . powered by famous General Motors 2-cycle diesel engines. The smooth operating HD-19 — 40,000 lbs. — is the WORLD'S LARGEST TRACTOR and has a hydraulic torque converter drive (exclusive with Allis-Chalmers) . . . outperforms, outpulls any tractor ever built. Matched Allied equipment for all models.

...IT'S AC WHEEL-TYPE TRACTORS

for fast, economical mowing, sweeping, snowplowing and countless pulling and pushing jobs around tank farms, refineries and other buildings. Two models — B and IB. Both provide 13½ drawbar h.p., 16.31 on belt; available with rear power take-off and belt pulley, other attachments. Model IB is built lower and has a mounting frame for attaching auxiliary equipment. The IB is also available with fixed, front-end crane and other equipment.

...IT'S AC MOTOR GRADERS



for building and maintaining haul roads, tank farm lands, parking lots and yards, and for scarifying. For light work, use the economical, general purpose W-Speed Patrol — gasoline powered . . . ideal for operation in narrow quarters. For heavy work, there's a choice of four diesel-powered sizes — 50.5 to 104 brake h.p. . . . provide a full range of blade positions, high throat clearance, extra traction and direct down pressure of blade for more accurate work.

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for powering pumps, winches, welders, drills, compressors, generators, pipe cleaners and straighteners, rock crushers, elevators and hoists, all kinds of oil field servicing equipment. Heavy-duty in every respect — designed for tough tractor service — stand up on toughest going. Slow speed, high torque — hang-on to overloads like "steam power." Operate on gasoline, low grade fuel, distillate, butane, natural gas. Five sizes — from 74 to 590 ft. lbs. torque.

* These engines sold exclusively to the petroleum industry through Fred E. Cooper, Inc., Tulsa, Oklahoma.

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WORLD-WIDE SERVICE . . .
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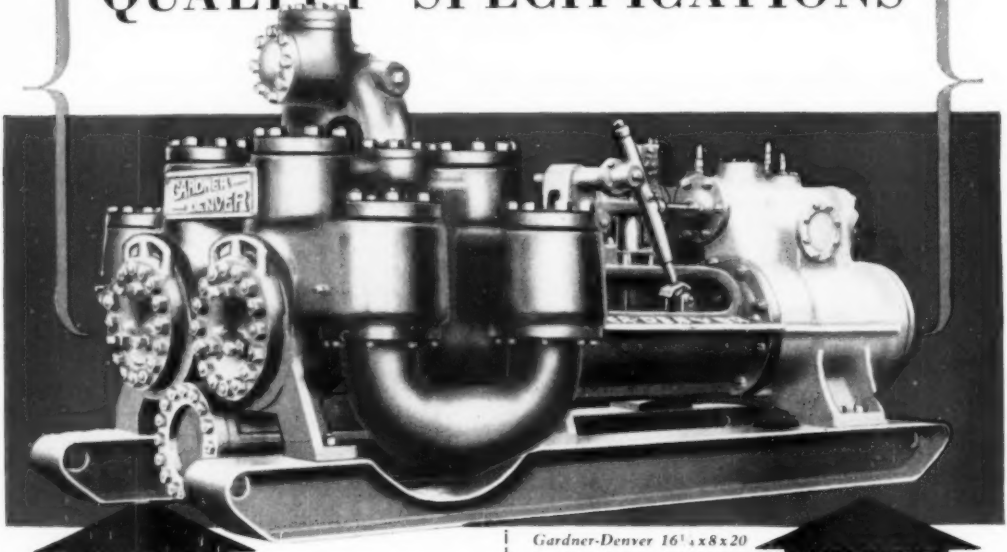
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

We make both ends meet
QUALITY SPECIFICATIONS



Gardner-Denver 16¼ x 8 x 20 Duplex Steam Slush Pump.

★ Divided cylinder fluid end construction of GarDurloy alloy specially developed for mud pump service. No inner baffles or metal sections to be cut through by mud.

★ Slush-Proof Duo-Seat Fluid Valves. Combination steel and rubber seat makes valves tight, durable and efficient.

★ Slush-Proof, Hardened Liners, Pistons and Piston Rods are heavy and long-wearing.

★ Smooth, easy curves and large size of manifold reduce suction friction to a minimum.

★ Readily accessible stuffing boxes hold ample packing to withstand severe operating conditions.

★ Special GarDurloy close-grained nickel alloy steam cylinders designed for 400 lbs. working pressure.

★ Balanced piston steam valves are extra steam-tight—move with a minimum of friction.

★ Roller bearings steam valve motion with telescopic levers is unusually quiet and efficient.

★ Steam ports designed for maximum economy and safety. Large exhaust port and manifold provide greater steam economy.

★ Mechanical force-feed lubrication assures positive lubrication of steam valves and steam cylinders.

For further information on Gardner-Denver Steam Slush Pumps—the pumps built with extra strength and exceptionally high safety factors for deep hole drilling—write Gardner-Denver Company, Quincy, Illinois.

In Canada: Gardner-Denver Company (Canada) Ltd., Toronto, Ontario.

GARDNER-DENVER

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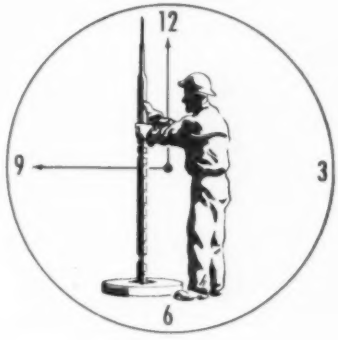
The

Schlumberger

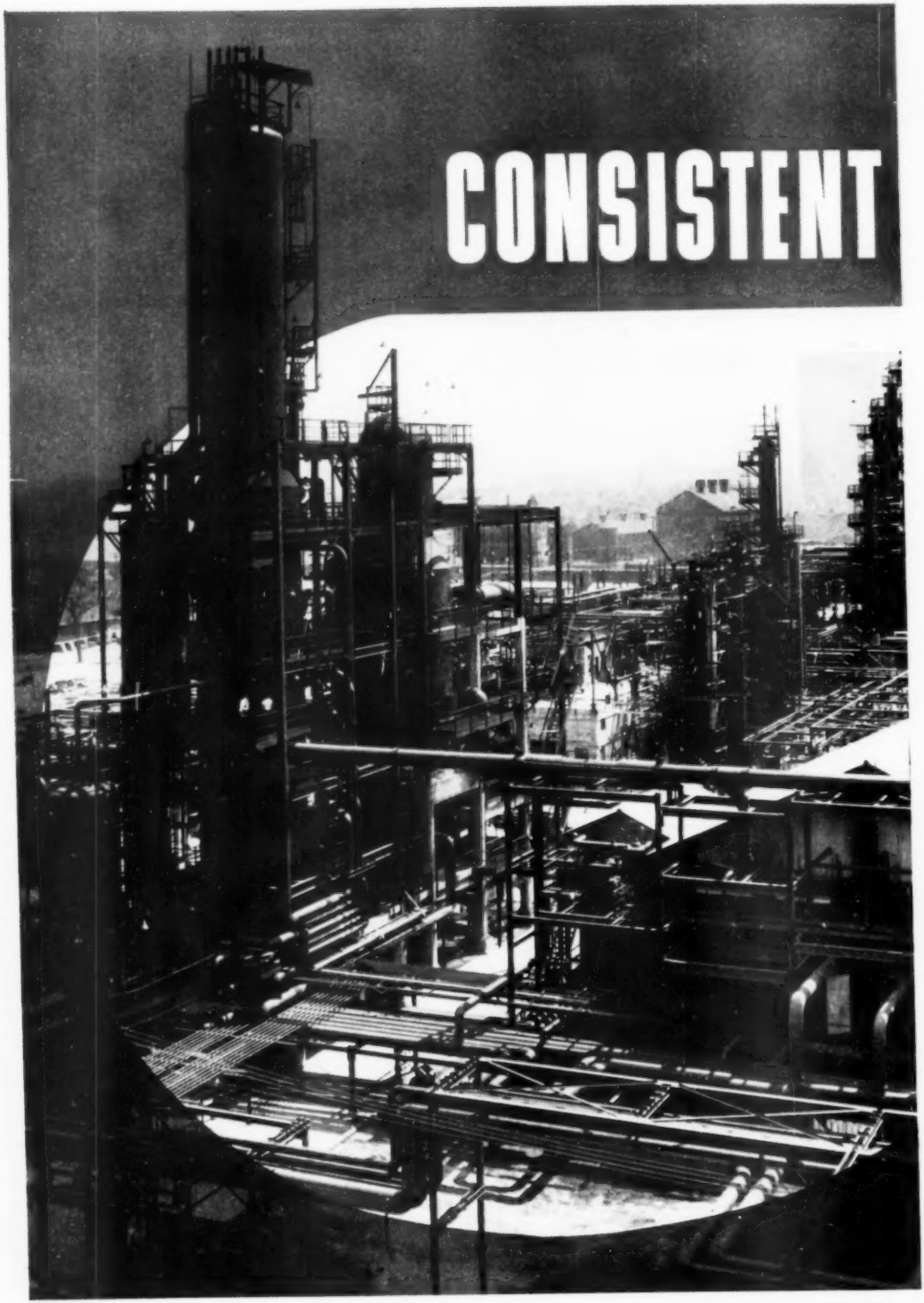
electrical log saves you hours

of costly rig time

● Schlumberger Recording Cameras and instruments are designed to record several curves at one time and two films simultaneously. Thus, the necessary curves can usually be obtained on one trip in the hole with substantial savings in rig time and greater safety to crews and well bore investment. When you call Schlumberger, you get the best!

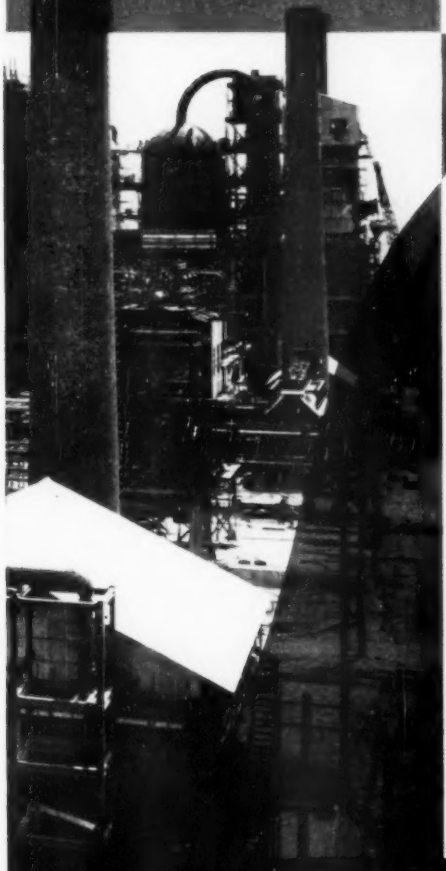


SCHLUMBERGER
WELL SURVEYING CORP.
HOUSTON, TEXAS


CONSISTENT

PROGRESS

in "The Heart of the Refinery"



This 32,000 barrel combination atmospheric-vacuum topping unit at Gulf Refining Company's Toledo, Ohio, refinery produces light and middle distillates as well as high quality catalytic cracking feed stock from sweet or sour crudes.

Wartime experience demonstrated the necessity for independent primary distillation facilities to maintain refinery balance when processing varying crudes. Hence this is the fourth two-stage unit which Badger has completed for Gulf's post-war program. All were engineered for wide flexibility in operation and with corrosion protection as determined by the economic balance between installation and maintenance costs.

E. B. BADGER & SONS CO. · Est. 1841

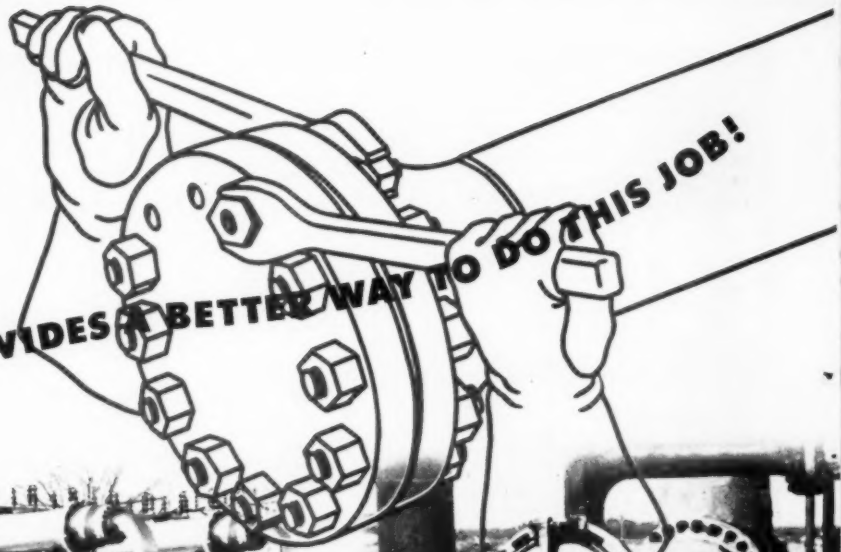
A SUBSIDIARY OF STONE & WEBSTER, INC.

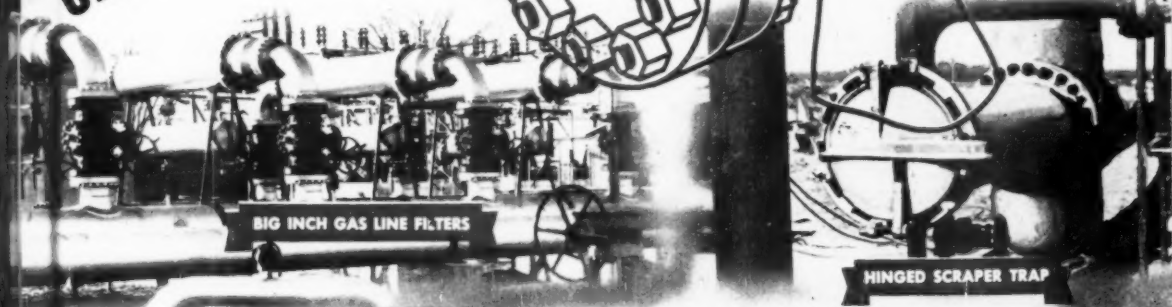
BOSTON 14 · NEW YORK · SAN FRANCISCO · LOS ANGELES · LONDON

Process Engineers and Contractors for the Petroleum, Chemical and Petro-Chemical Industries

GAS LINE BLOW-DOWN

UNIBOLT PROVIDES A BETTER WAY TO DO THIS JOB!

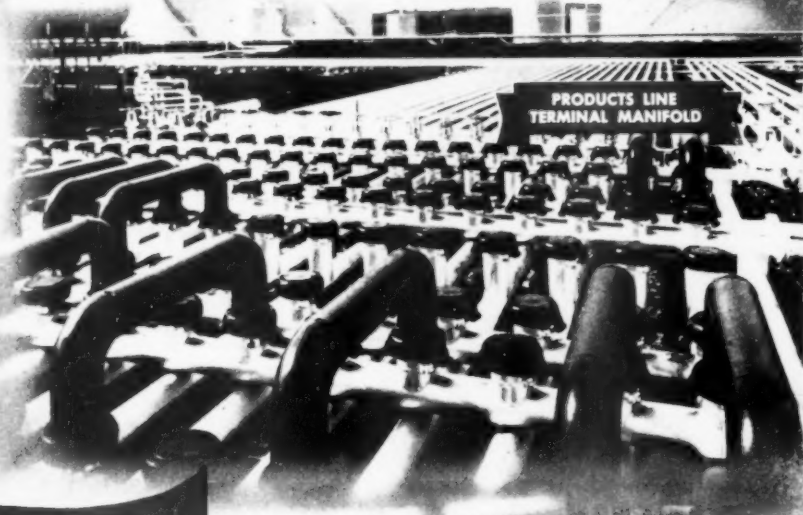




BIG INCH GAS LINE FILTERS

HINGED SCRAPER TRAP

GAS LINE BLOW-DOWN AND BY-PASS



PRODUCTS LINE TERMINAL MANIFOLD

Whenever flanged closures or connections are employed, there UNIBOLT Couplings and Blanking Plugs may be utilized to: (1) Provide a safer, stronger joint because the unique UNIBOLT design places more metal in shear; (2) Provide a more convenient closure or connection because of its time-saving two-bolt design and hinged type Blanking Plugs; (3) Provide a light-weight, less bulky unit which is economical, completely salvageable and interchangeable.

Pipeliners and fabricators are invited to write for UNIBOLT Bulletin PL-49 which contains complete mechanical details and helpful suggestions on the use of UNIBOLT Pipeline Couplings.

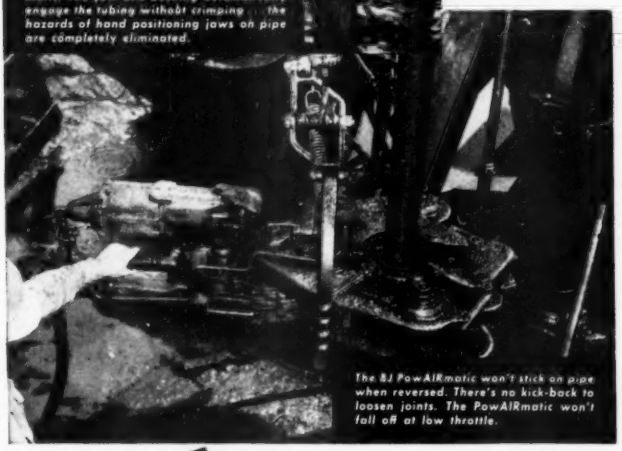
SCRAPER TRAP

THORNHILL-CRAVER CO.
HOUSTON, TEXAS

BJ POWAIRMATIC

the engineered tubing tong

One man stabs the pipe with the PowAIRmatic. The jaw and bushing automatically engage the tubing without crimping . . . the hazards of hand positioning jaws on pipe are completely eliminated.



The BJ PowAIRmatic won't stick on pipe when reversed. There's no kick-back to loosen joints. The PowAIRmatic won't fall off at low throttle.

PowAIRmatic advantages:

- **POSITIVE**-acting Positioning Valve . . . no manual positioning required
- **SIMPLE** Inner Ring Assembly has only 21 parts
- **EVEN GRIP** without crimping or crushing
- **RUGGED** Roll-over Hanger Assembly . . . no chain adjustment
- **QUICKLY** interchange jaws and bushings
- **EXCLUSIVE** Torque Indicator gives positive control for uniform make-up of pipe and tubing
- **SAFE** to operate. Rotating mechanism completely enclosed. Jaws grip, release and position automatically. No danger of losing fingers.

THE BJ POWAIRMATIC is engineered for long wear and maximum performance. Its superior design results in greater efficiency and effectiveness on production and workover jobs. Considered from all angles . . . speed . . . ease of operation . . . security against collar leaks . . . you'll find the *PowAIRmatic* the only Tubing Tong designed to do all your work.

JUDGE FOR YOURSELF the overall efficiency of a BJ *PowAIRmatic.* Write for the new bulletin, or ask your local BJ Representative to arrange a demonstration.

BJ

means engineered oil tools

Byron Jackson Co.

Since 1872

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G-E 2-Way Radio

"Greatest time-saving tool in the oil industry!"

"The General Electric 2-Way Radio is the greatest time saving tool that has been introduced to the oil industry in my twenty years of experience. For example . . . last night I was in complete control of operations running simultaneously on four rigs scattered within a 150-mile radius of Abilene.

"On rigs 5 and 7 we were running drill stem tests, on rig 11 we were running a fishing job, while on rig 8 we had lost circulation.

"Without our General Electric 2-Way Radio we could have run only one of these operations, having to shut down the other three . . . This means that *in just one night's operation we saved eight hours shut-down time!*"

Edgar Davis
President
West Central Drilling Company
Abilene, Texas

For full information, call the G-E office nearest you, or write for this FREE BULLETIN on G-E 2-Way Radio: *General Electric Company, Building 3, Electronics Park, Syracuse, N. Y.*

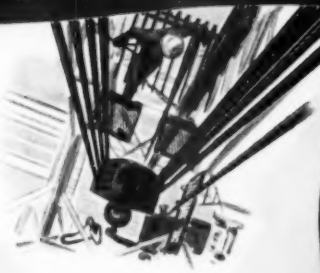
You, too, can put your confidence in

GENERAL ELECTRIC

OPERATORS DEMANDED IT...

here it is...

THE NEW EMSCO P-36 TRAVELING BLOCK



Traveling block rubber bumper built in top bracket.

36" alloy steel, precisely-balanced sheaves. Flame-hardened grooves maintain ideal sheave groove contour minimizing wear on wire line.

Timken double row, tapered bearings assure freely rotating sheaves and fast-dropping empty blocks. Large diameter bearing races provide maximum load capacity per unit of width.

9¼" diameter center pin.

Bearings individually grease-lubricated by means of the centralized system. Bearing assemblies sealed against intrusion of foreign matter and leakage of grease.

Center pin can be rotated to new position to equalize wear.

Close proximity of bearings to sheave groove prevents tilting of block minimizing wear on wire line, bearings and sheaves.

A quick-opening, positively-locked lower clevis.

A HIGH CAPACITY BLOCK DESIGNED, ENGINEERED AND CONSTRUCTED FOR PORTABLE MAST OPERATION

Here's the traveling block you asked for—a compact, high capacity, 4-sheave block developed especially for use with portable masts. Its extremely narrow, short construction permits its use with the slenderest of masts; yet its 225-ton rated capacity meets the requirements of deep portable mast drilling. The P-36 is completely streamlined. It is heavy enough to assure fast dropping, non-tilting empty block, yet light enough to eliminate any possibility of it becoming hung-up during raising and lowering of mast. These are just a few of the features that make the new P-36 block the No. 1 choice for your portable mast.

SHORTER, NARROWER CONSTRUCTION

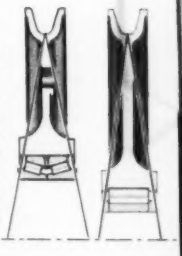
The 22¾" width, 40⅝" face and 82⅝" length make the P-36 the narrowest, thinnest and shortest 225-ton, 4-sheave block in the market. The streamlined, compact and light weight (5500 lb.) design makes it the outstanding block for portable masts.

50% LARGER BEARINGS

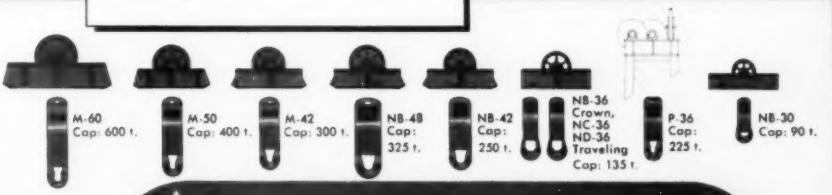
The P-36 has 50% larger diameter bearing races than conventional 36" sheave blocks. The larger diameter permits use of narrower bearing reducing width of block. Larger bearings also provide smoother operation, longer life.

GREATER SHEAVE STABILITY

The large bearing races position bearings closer to sheave groove. This adds pyramidal stability to sheaves. They are perfectly supported. Sheave tipping and wobbling are eliminated. Wear on wire line, bearings and sheaves is minimized.



Emsco crown and traveling blocks are sturdy, easily handled, easy to reeve, perfectly balanced, and incorporate all known safety features. Their design insures long, trouble-free performance. There is a size and type to meet every drilling requirement. Ask your nearest Continental-Emsco representative for information.



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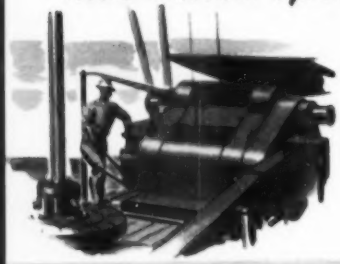
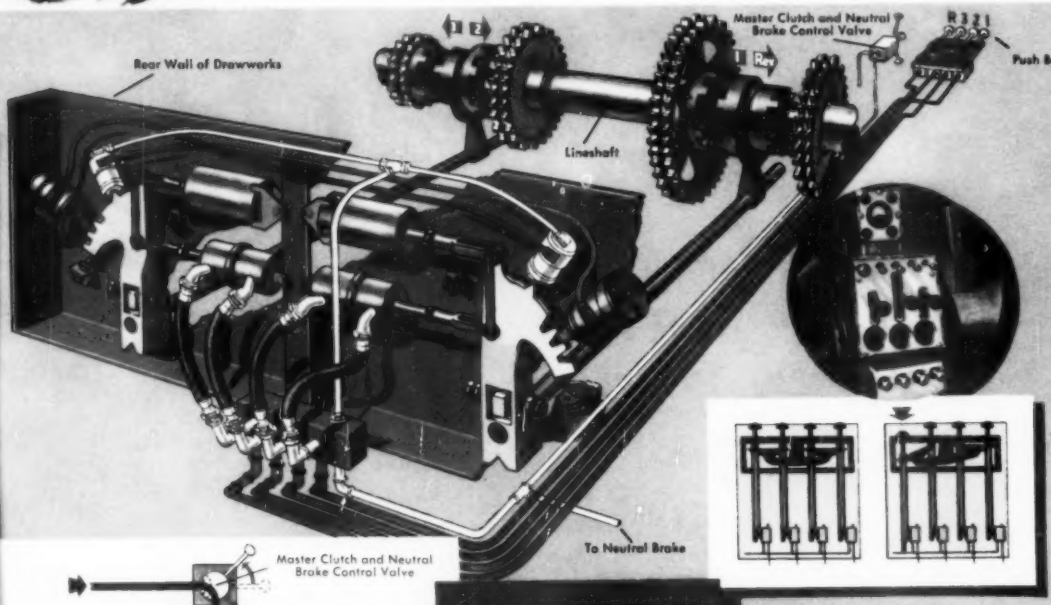
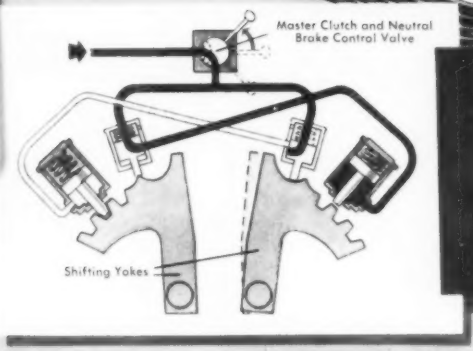
Push button speed selection

A SIMPLE, POSITIVE, TROUBLE-FREE METHOD FOR CHANGING SPEEDS IN DRAWWORKS SELECTIVE SPEED TRANSMISSION*



Field-proven air-operated controls make the 350 hp GA-350 Drilling Rig the safest, most efficient and modern rig of its class. All controls are conveniently located at the driller's position. Variable pressure valves control the direct air-operated friction disc clutches employed on the master, rotary and drum high drives. Push-button on-and-off valves control the Fawick Airflex engine clutches and the slush pump direct air-operated friction disc clutch. *In addition* to these outstanding air controls, Emsco GA-350 drilling rigs have a simple, unique push button air control system for operating splined multiple jaw clutches in the drawworks built-in selective speed transmission. Hoisting and rotary speeds may be changed instantaneously. The "fighting" of mechanical controls is eliminated; clashing of jaw clutches prevented; faster, more efficient operation assured. Speeds may be preselected. These air-operated controls combined with many other exclusive Emsco design features make the GA-350 drilling rig a fitting complement to the famous Emsco line of power rigs for drilling from 2,000 to 20,000 feet.





EMSCO GA-350 DRILLING RIGS

MECHANICAL INTERLOCK SYSTEM—A simple, positive linkage arrangement permits operation of only one push button at any one time. There are four control valves; one for each clutch. These valves are actuated by four mechanically-interconnected shafts. As one push button is moved to "on" position, all other push buttons are automatically locked in "off" position before desired control valve is actuated.

AIR INTERLOCK SYSTEM—A trouble-free air-controlled mechanical lock system positively prevents operation of any one jaw clutch unless all other jaw clutches in the selective speed transmission are disengaged. It also prevents operation of jaw clutches while shafts are rotating. Shifting quadrants are locked in position unless neutral brake is applied and shifting quadrant of opposite side is in neutral clutch-disengaged position.

DISTINCTIVE FEATURES OF EMSCO GA-350 DRILLING RIGS

- ★ Push Button Speed Selection
- ★ Complete Pressure Oil Lubrication of Entire Rig
- ★ Direct Air-operated Friction Clutches Throughout
- ★ Two or Three Engine Compounding Transmission
- ★ Six Hoisting Speeds; Three Rotary Speeds; One Reverse
- ★ Available With or Without Sand Reel
- ★ Complete Rig Mounted on Skid Base Within Roadwidth Restrictions

*Patent Pending.

EMSCO
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EMSCO DERRICK & EQUIPMENT COMPANY
Houston, Texas • LOS ANGELES, CALFORNIA • Dallas, Texas
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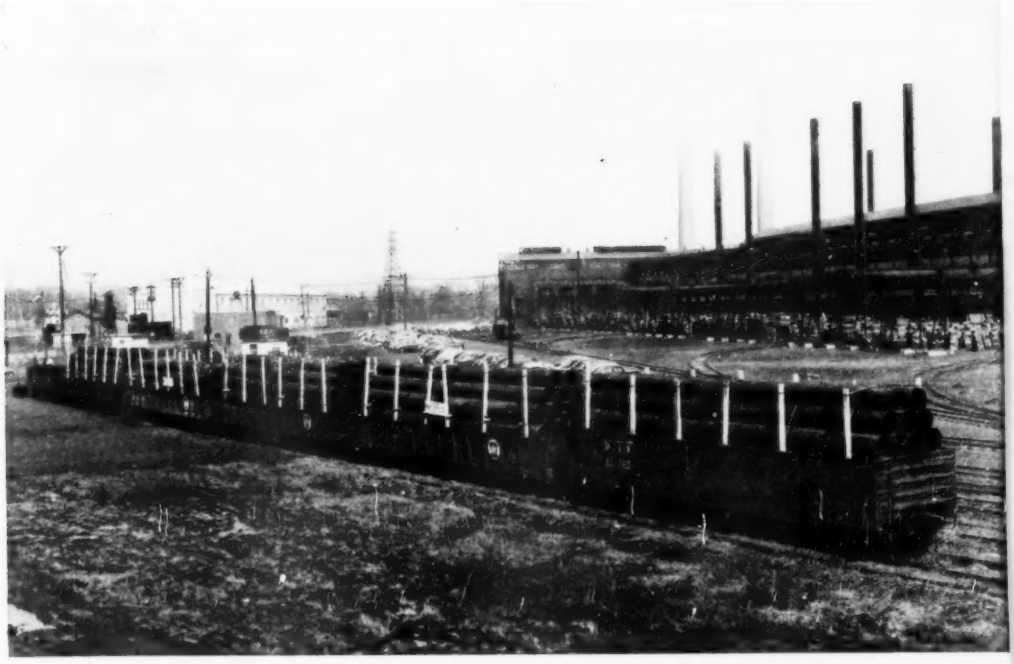
WORTH WELDED STEEL PIPE



ON ITS WAY TO OIL & GAS FIELDS THROUGHOUT THE WORLD

. . . to transmit gas from field to plant and terminal. Worth—long a leader in the production of Quality Steel Plate and Heads, controlled from the ingot to finished product, is supplying a goodly portion of Expanded Welded Steel Pipe—in 20", 24", 26", 30" and 36" O.D.—to refineries and oil fields throughout the world. Write for detailed information.

ALSO PRODUCERS OF CARBON AND STAINLESS CLAD STEEL PLATES • FLANGED AND DISHED HEADS

WORTH STEEL COMPANY · Claymont, Delaware

The WILSON SUPPLY-INGERSOLL-RAND *Packaged-Portable* COMPRESSORS

The photograph above shows FOUR Wilson Supply—Ingersoll-Rand Packaged Portable Compressors—leaving the plant in Houston—headed for South Texas.

In a matter of hours these four machines will be "In Service", as they require only the connecting of suction and discharge line, to be put in operation.

The Packaged Portable Units are available in both "Single Stage" and "Two Stage" and in sizes ranging from 10 H.P. to 140 H.P.

Especially adaptable for gas—oil lift, repressuring and pressure maintenance—these Portable Units take the place of far more costly permanent installations. They afford a worthwhile saving on simplicity of maintenance and availability of service.

Check your needs NOW—and let our engineers work with you on how they can best be met with these PROVEN PERFORMANCE UNITS.

For complete information on this worthwhile equipment, address Compressor Division, Wilson Supply Co., P. O. Drawer 19, Houston Texas.

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SALES OFFICES: Tulsa, Oklahoma; Dallas, Texas

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BRANCH STORES: TEXAS—Alice, Corpus Christi, Victoria, Bay City, Columbus, Barbers Hill, Beaumont, Kilgore, Monahans. LOUISIANA—Lake Charles, New Iberia, Houma, Harvey, Shreveport. ARKANSAS—Magnolia.

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EXPLORATIONS, INCORPORATED
Established 1953

VALVES...

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Let Republic take over your valve problems. Walworth lubricated plug valves in iron and steel, in all pressures. Walworth brass, iron and steel gate, globe and check valves . . . . available now from Republic's 50 convenient locations.

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For Larger Gas Engines...

ENSIGN offers New Models

New requirements in both the petroleum and transportation industries call for larger and more powerful engines—hence larger and more compact carburetors.

The Ensign model "Dg," a new carburetor for natural gas and butane-propane was laid out in sizes ranging from $2\frac{1}{2}$" to 4" to handle engines up to 500 Horsepower.

Outstanding features of the new "Dg" are:

1. *Built-in fixed orifice economizer for part throttle operation.*
2. *Instant starting, utilizing separate set of gas-air orifices.*
3. *Provisions for balancing air-fuel ratios against air entrance losses.*
4. *Interchangeable venturii for easy adaptation of carburetor to meet wide range of engine operating conditions.*
5. *Universal in application. Updraft or downdraft. Airhorn, throttle tube and entire carburetor movable radially on 90 degree centers. Throttle levers and stops may be used on either side.*

These and other important carburetor features have been carefully worked out to result in finest engine performance in both power and economy.

Engine builders and operators can expect the same high degree of satisfaction and long life from the new Ensign "Dg" line as they have experienced from Ensign carburetors for over 38 years.

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GIVE YOUR CHRISTMAS TREES

MASTER GATE SAFETY ALL OVER

WITH DEPENDABLE W-K-M GATE VALVES

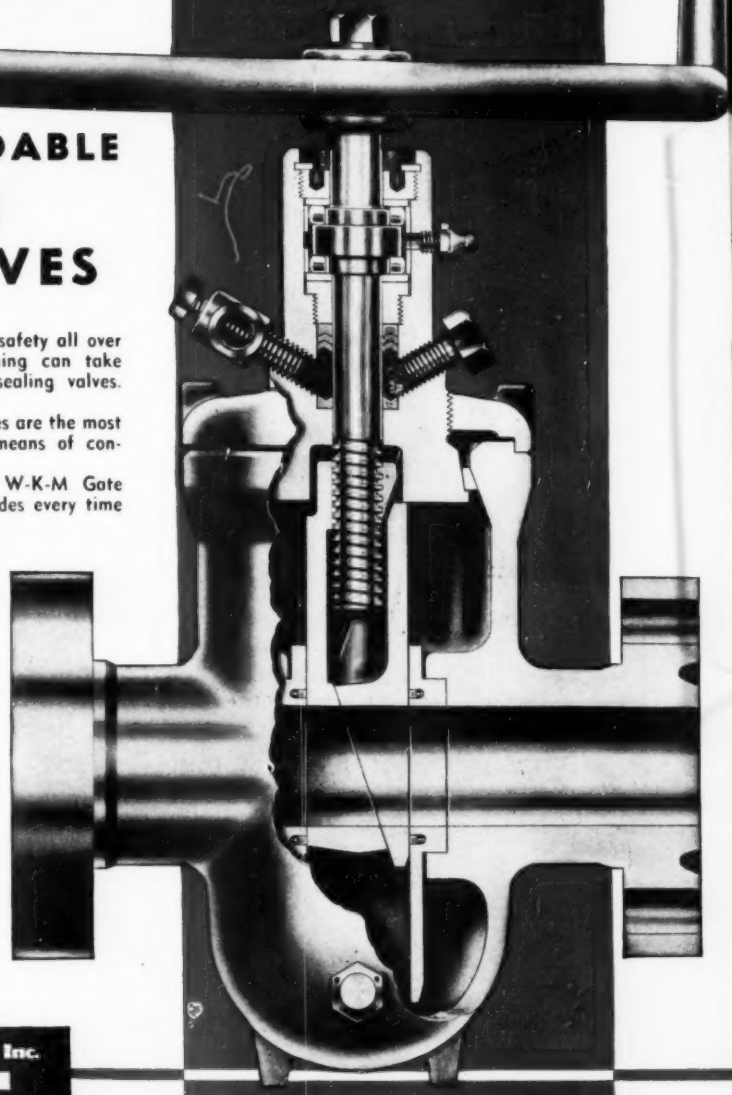
If you suddenly need master gate safety all over your Christmas Tree controls, nothing can take the place of dependable, positive sealing valves. "Gadgets" can't "cut it."

In the long run, W-K-M Gate Valves are the most economical and by far the safest means of controlling high or low pressure wells.

For safety, you can depend on W-K-M Gate Valves to seal completely on both sides every time against full rated pressure. You can be sure that W-K-M Gate Valves will not bind or freeze . . . will open or close easier than any other valve.

For economy, you can depend on W-K-M Gate Valves to give longer life with less maintenance. And after the first life of service, they can be economically renewed for another indefinite period of safe service.

So give your Christmas Trees master-gate safety all over with dependable W-K-M Gate Valves. They are safety insurance . . . additional assurance that your well is always under control. Specify W-K-M Valves. They now control more than 80% of all high pressure wells in the world.



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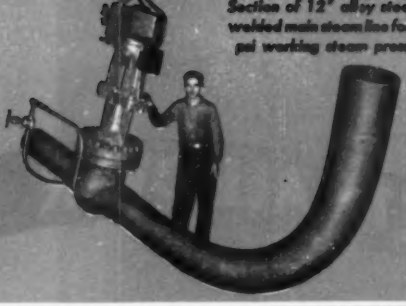
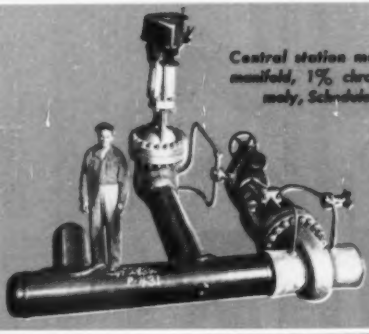


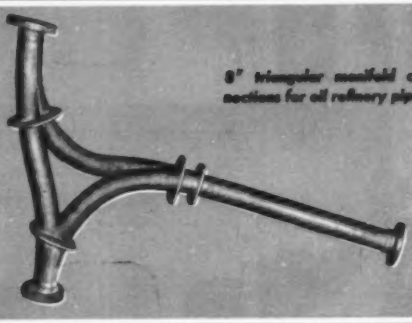
Section of 12" alloy steel all-welded main steam line for 900 psi working steam pressure.

YOU SAVE Time and Money IN ERECTION by Using MIDWEST PREFABRICATED PIPING

Pump discharge header for glass furnace circulating water system.



Central station main steam manifold, 1¼ chrome, ½% moly, Schedule 100.



8" triangular manifold connections for oil refinery piping.

Bleeder piping manifold for steam turbine fabricated from 24" and 20" pipe and Midwest Welding Fittings.

Midwest Prefabricated Piping is precision piping . . . that is why it saves time and reduces the cost of field erection. Being contractors as well as fabricators, we know from long experience the importance of having the subassemblies accurate to dimension and alignment. Before shipment from any of the four modern Midwest shops, pieces are checked for dimensional accuracy and thoroughly cleaned to remove scale and dirt by turbinizing or acid pickling as may be specified. Careful inspection and pressure testing are other characteristics of Midwest Prefabricated Piping methods.

Another important reason for the ease of erection and economy of Midwest piping is the fact that the difficult operations are performed in the fabricating plant and field welding is simplified. Here again our extensive erection experience enables us to effect savings by locating field joints where they are easy to make.

You will find it to your advantage to use Piping by Midwest . . . it saves time, money and trouble.

MIDWEST PIPING & SUPPLY CO., Inc.

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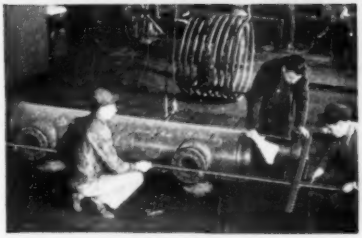
4 PLANTS ARE BETTER THAN 1

CHECKING DIMENSIONS AND ALIGNMENT

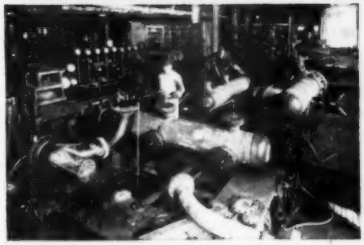


The careful check given every prefabricated subassembly before it leaves any Midwest shop saves time and trouble in field erection.

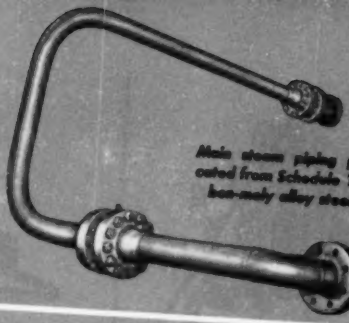
THOROUGH CLEANING

Prefabricated subassemblies are thoroughly cleaned before shipment from any Midwest plant and are turbinized when specified.

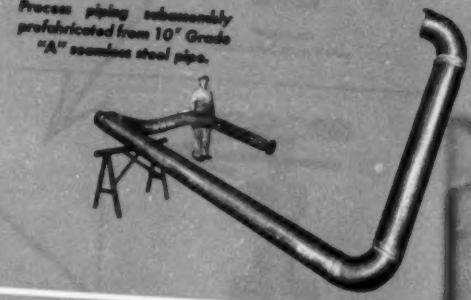
CAREFUL TESTING



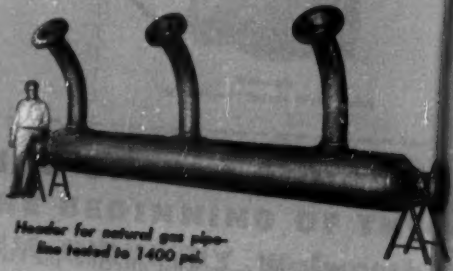
All Midwest plants have complete facilities for testing piping assemblies to assure their ability to withstand the most severe operating conditions.



Main steam piping prefabricated from Schedule 120 carbon-moly alloy steel pipe.

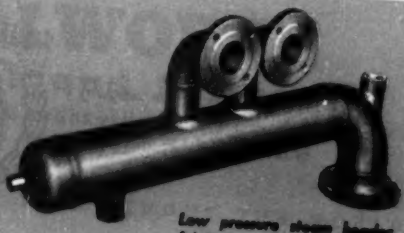


Process piping subassembly prefabricated from 10" Grade "A" seamless steel pipe.

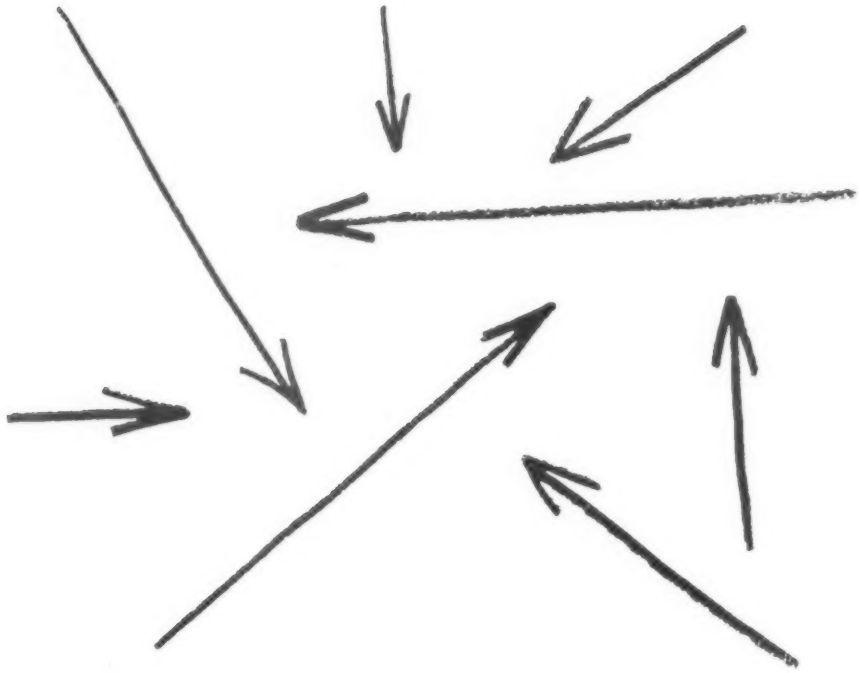


Header for natural gas pipeline tested to 1400 psi.

Prefabricated subassembly of 24" OD x ½" wall seamless steel pipe for oil refinery.



Low pressure steam header fabricated from 6" and 3" pipe and Midwest Welding Fittings.



They're all the same to a TIMKEN bearing

NO MATTER from what direction the loads may come, Timken® roller bearings carry them all safely—dependably. Timken bearings are tapered in design—carry both radial loads, thrust loads and any combination of them.

With Timken bearings in your product, auxiliary thrust bearings and thrust plates are eliminated. Designs can be simplified, space saved, cost reduced.

You have a better-working product, too. The tapered construction of Timken bearings prevents end-play and holds shafts in proper alignment. Wear on surrounding parts is reduced; gears mesh more smoothly.

And Timken tapered roller bearings give you these added advantages: Due to the line contact between rolls and races, they have extra load carrying capacity. True rolling motion and smooth surface finish practically eliminate friction. Timken bearings permit the use of closures which keep lubricant in—dirt out. And since they're made of Timken fine alloy steel, Timken roller bearings normally last the life of the machine in which they are used.

Dependable performance and public acceptance of Timken bearings have made Timken-bearing-equipped products first choice throughout industry. They add a valuable sales feature in your product—build greater acceptance among customers. When you specify bearings for your product, specify "Timken". And when buying new equipment, always look for the trade-mark "Timken" on the bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

50th birthday of the company whose products you know by the trade-mark: TIMKEN

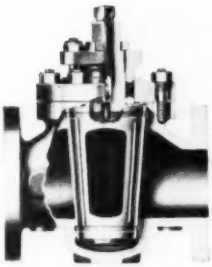
TIMKEN 50 YEARS

TIMKEN

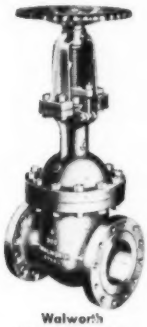
TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

● VALVES
● PIPE FITTINGS



Walworth
Lubricated Plug Valve



Walworth
Steel Gate Valve

Walworth
Iron Body Gate Valve

Walworth
"500 Brinell" Bronze Globe Valve

Walworth
Iron Body Saddle Gate Valve

Walworth
Cast Steel Flanged Fittings

SINCE THE BEGINNING OF THE PETROLEUM INDUSTRY Walworth has been supplying producers and refiners with the quality products they demand . . .

The petroleum industry knows that years of engineering experience and development are back of all Walworth Valves and Pipe Fittings. Quality of workmanship, design and material are combined in every Walworth product to assure long years of trouble-free service.

The valves and fittings shown here are typical of Walworth's complete line of steel, iron, bronze, and special alloy valves and fittings.

You can get all the facts about the complete Walworth line in the 600 page Catalog 47. Write for a copy.

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valves and fittings

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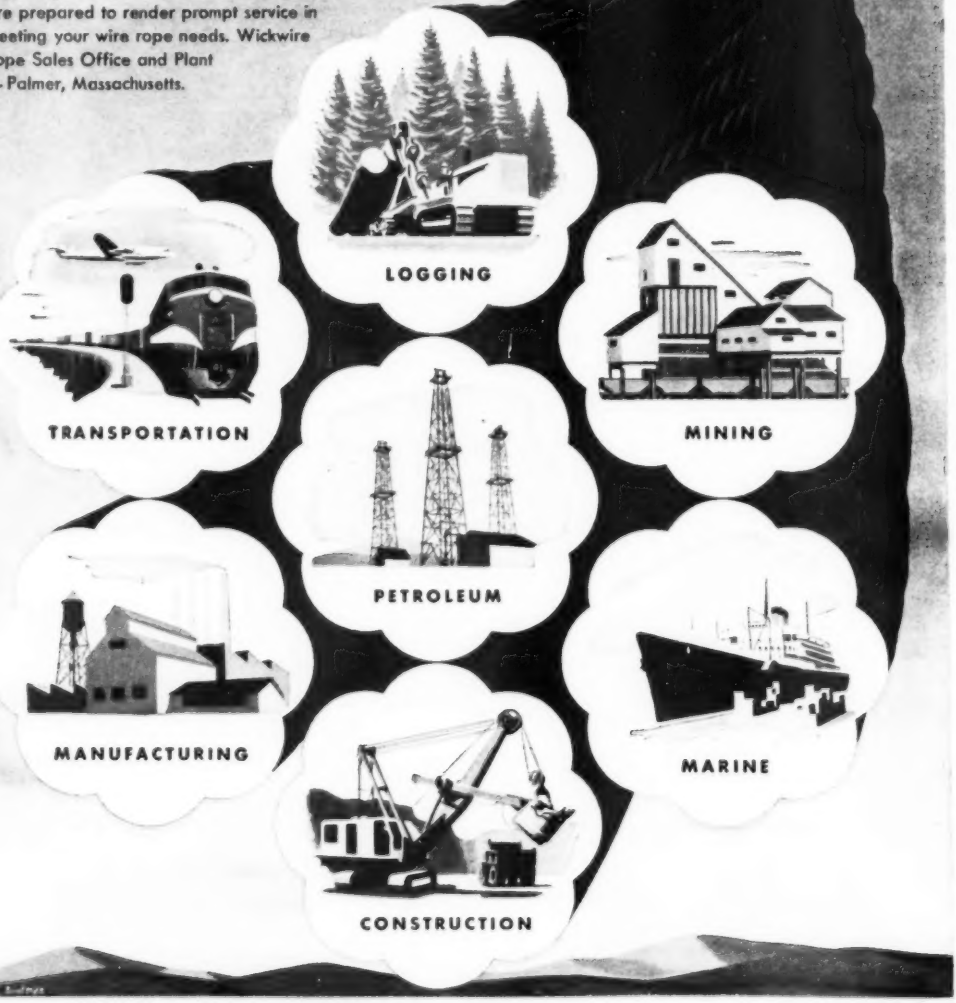
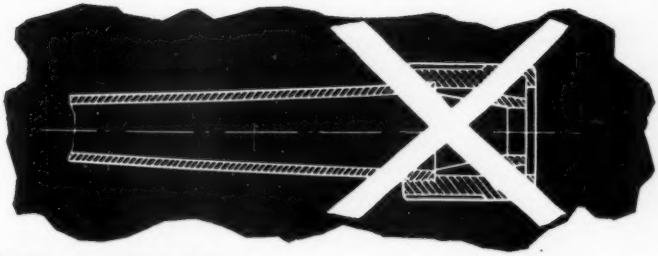
In scores of industries, users of Wickwire Rope have developed an affectionate respect for its performance, safety and long life. And, for true economy, they use Wickwire's WISSCOLAY® *Pre*formed. It lasts longer—is easier to cut, splice and install. It's kink-resistant and safer to handle. Wickwire Distributors and Rope Engineers, in key cities everywhere, are prepared to render prompt service in meeting your wire rope needs. Wickwire Rope Sales Office and Plant —Palmer, Massachusetts.



IN THE EAST—Wickwire Spencer Steel Div. of C. F. & I., 500 Fifth Ave., New York 18, N. Y. • IN THE ROCKIES—The Colorado Fuel and Iron Corp., Continental Oil Bldg., Denver 2, Colo.
ON THE WEST COAST—The California Wire Cloth Corp., 1060—19th Ave., Oakland 6, Cal.



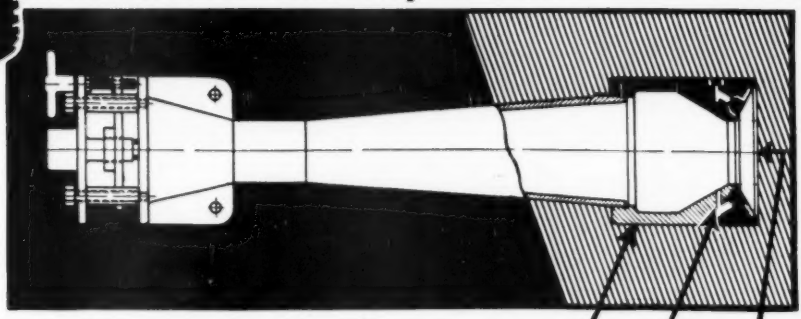
NOT THE OLD TYPE NOZZLE,
But, THE NEW TYPE NOZZLE...

"AIROCOOL" GAS BURNER NOZZLES

PATENTED

NATIONAL AIROIL FUEL OIL - GAS BURNERS

...outlast the ordinary nozzle 2 to 5 times



OIL BURNERS and **GAS BURNERS** for industrial power, process and heating purposes; **STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS,** for small process furnaces and heating plants; **FUEL OIL HEATERS, FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.**

Our "AIROCOOL" Nozzles have the "earned" reputation of outlasting under fire, *two to five times,* the ordinary inspirator gas burner nozzles. Consequently, they reduce the frequent labor costs, inconvenience, and overhead item of making replacements.

Renewable type recessed gas tips direct the separate igniter flames against the main volume of the mixture to insure stable ignition . . . and allow greater turn-down without burn-back.

"AIROCOOL" Nozzles are made exclusively by us. They are stocked for standard pipe thread sizes 4, 5, 6 and 8 inch for various makes of inspirators. Ask for Supplement 3 to Bulletin 55 . . . it gives detailed information.

NATIONAL AIROIL BURNER CO., INC.

Main Offices & Factory: **1236 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.**

Texas Office: 2512 South Boulevard, Houston 6

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

An Oliver "Cletrac" with side boom hard at work taking up 16-inch pipe. 51 miles of 16-inch and 6 miles of 12-inch pipe were taken up from Drumright to Seminole.

WITH OLIVER "Cletrac" !

Handling long strings of pipe is easy with an Oliver "Cletrac" crawler tractor. The "straight-line" travel of these husky tractors is made-to-order for pipe line work. Regardless of the side drag of side-mounted equipment and side loads, they travel straight ahead . . . eliminate waste motion . . . save time and fuel.

It's the exclusive Oliver "Cletrac" steering principle that gives you this important *plus* advantage. One track can be speeded up . . . the other slowed down to compensate for the side pull of the boom and load of pipe. The wasteful zigzag required by the ordinary tractor when a heavy side pull is present is eliminated. An Oliver "Cletrac" can travel parallel to and well away from the trench to minimize the danger of cave-ins.

For pipe lining, for clearing right-of-ways, for road building, preparing river crossings, back-filling, hauling equipment around the rigs, an Oliver "Cletrac" is the oil field favorite. Your Oliver "Cletrac" dealer will be glad to give you the complete story. The OLIVER Corporation, Industrial Division: 19300 Euclid Ave., Cleveland 17, Ohio.

Cletrac

a product of

The OLIVER Corporation

A complete line of Crawler and Industrial Wheel Tractors

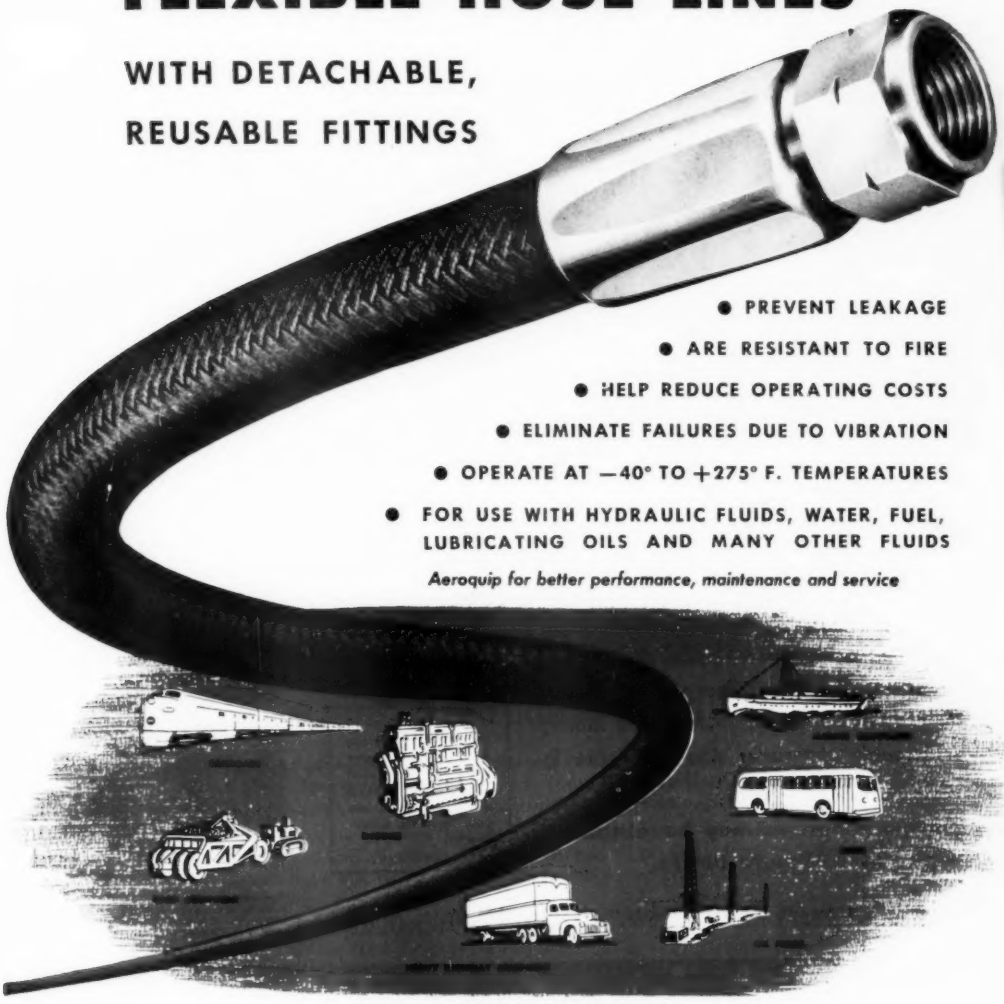
"THE SIGN OF EXTRA SERVICE"

OLIVER Cletrac SALES SERVICE

Aeroquip

FLEXIBLE HOSE LINES

WITH DETACHABLE, REUSABLE FITTINGS



- PREVENT LEAKAGE
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LIMITORQUE MOTOR OPERATED VALVE CONTROLS
are in successful, daily operation

... ON OIL PIPE LINES
all over the world

"LimiTorque" operates by the "push of a button," from either remote or nearby control panel . . . prevents damage to stem, seat, disc, gate or plug, because the Torque Seating Switch limits the torque, and thereby, shuts-off the motor, before trouble can occur. Thousands are in daily use on land and sea.

LimiTorque Controls may be obtained through Valve Manufacturers.

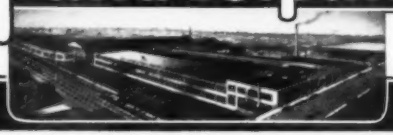
The 96-page Catalog on LimiTorque Valve Controls will be sent upon request. When writing, please use your business letterhead.

Type "SM" LimiTorque

The word "LimiTorque" has a definite meaning because an exclusive patented Torque Switch actually limits the torque applied to the operating parts.

There's a Reason for Such Widespread Acceptance

Philadelphia Gear Works, INC.



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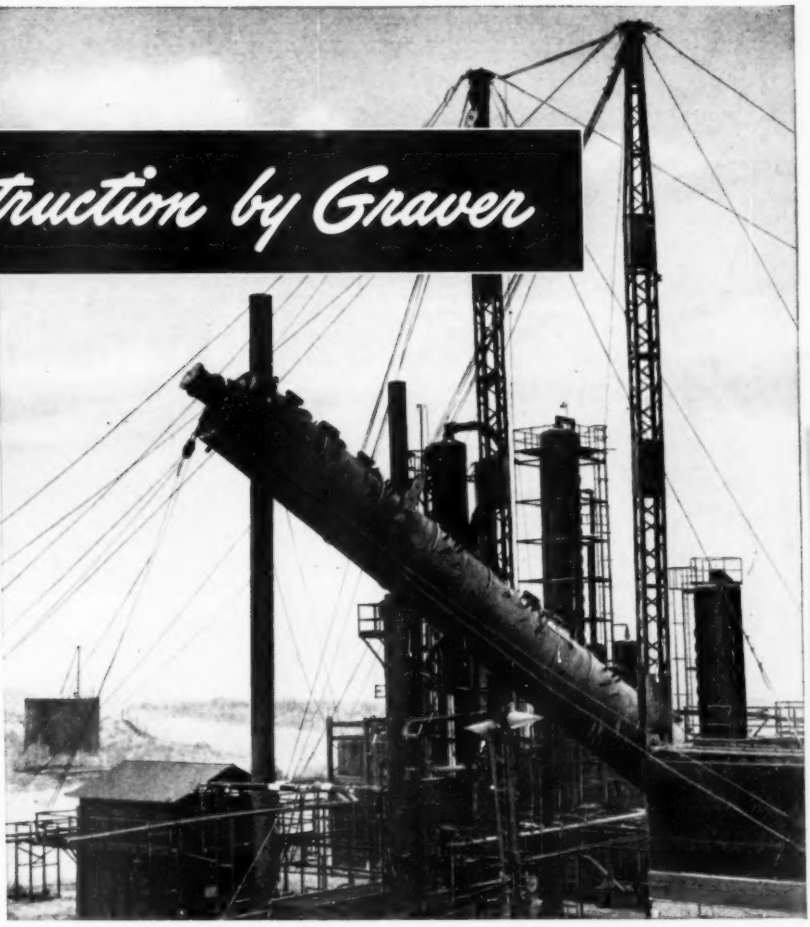
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Construction by Graver



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you call the best in the oil patch for..

Running and Pulling OTIS SUB-SURFACE CONTROLS • TUBING CORROSION SURVEYS • PERFORATING AND CUTTING OFF TUBING • Running and Pulling TUBING and DRILL PIPE UNDER PRESSURE

When an OTIS crew moves on your location, the entire OTIS organization is standing by – ready if needed.

Should your well present an unusual high-pressure problem, OTIS personnel is immediately available – with exclusive techniques gained from years of experience in the pressure control business and equipped with special tools and equipment produced through modern engineering, manufacturing facilities, and research.

If you need routine or emergency Wire Line Service, or tubing or drill pipe run or pulled under pressure–call the ONLY organization that can *follow through all the way* on an "under-pressure" job. Call the best in the oil patch. *Call* OTIS!

PRESSURE CONTROL OTIS SERVICE – EQUIPMENT

OTIS PRESSURE CONTROL, INC.
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LOW COSTS all along the line

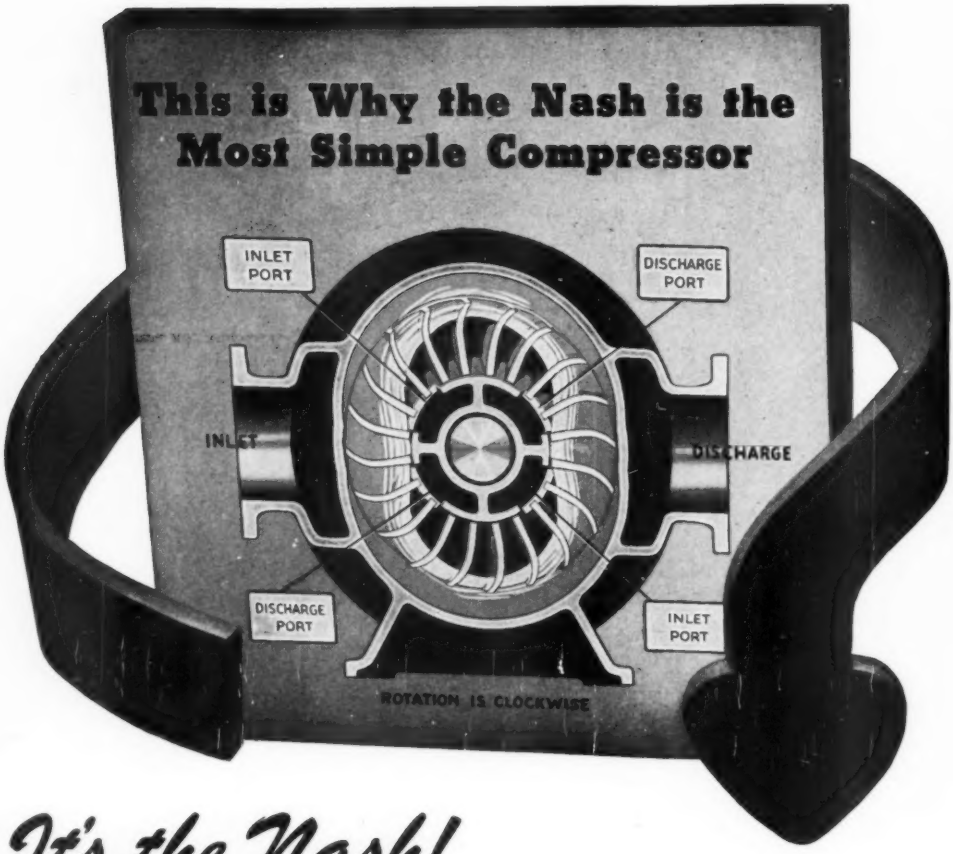
TOP: TRACKSON MD7 PIPELAYER makes overhead river crossing on 20" Colorado Pipe Line.

BOTTOM: ANGLEFILLER on PD4 PIPELAYER grades inside firewall on Illinois tank farm.

Throughout the world, Trackson Tractor Equipment plays a big part in laying cross-country pipe lines. These fast machines, powered by "Caterpillar" track-type tractors, are on the job from start to finish. TRACKSON PIPELAYERS carry, lift, load, lower, bend and cradle pipe — fast, efficiently and at lower cost. They are also used with ANGLEFILLER attachments to backfill, level, grade and do a host of other tasks. TRACKSON TRAXCAVATORS are used to clear rights of way, dig slush pits, level drill sites, build fire walls and dikes, or for any material-handling or dirt-moving job. See your nearest TRACKSON-"Caterpillar" dealer for complete information or write the TRACKSON COMPANY, Dept. OG-79, Milwaukee 1, Wisconsin.

TRACKSON
TRACTOR EQUIPMENT

This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
322 WILSON, SO. NORWALK, CONN.

for piping and fittings -

PC FOAMGLAS . . . THE PERMANENT INSULATION

PC Foamglas Pipe Insulation is available in two types—Regular or unwrapped, and Factory-wrapped. The Factory-wrapped material, as shown here, is provided primarily for high temperature applications. Both types are easy to apply.

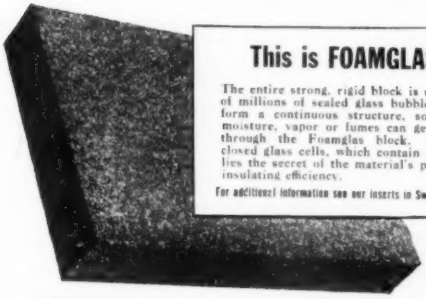
PC Foamglas Fitting Insulation is furnished unwrapped only, ready for application, or it may be fabricated in the field from standard Foamglas blocks or pipe insulation.

● PC Foamglas is the only pipe and fitting insulation that can be used for both hot and cold piping, indoors and outdoors. It is moistureproof, vaporproof, acidproof and fireproof. With PC Foamglas, you need no expensive vapor and weather protection, need not fear costly maintenance, repairs or replacement.

Foamglas Pipe and Fitting Insulation is fabricated to close tolerances to insure a close fit and to provide full thickness of insulation. The material is strong, rigid, light in weight. It is easy to cut and fit with ordinary tools, right on the job.

It takes an extraordinary insulating material to help maintain the exact temperatures required in process industries. PC Foamglas is giving long years of satisfactory service on all sorts of processing equipment, because, when properly installed, Foamglas retains its original insulating efficiency *permanently*.

Specifications and details regarding a wide variety of Foamglas installations on pipe lines and equipment have been published. Many of them are included in our new 24 page book on PC Foamglas Insulation for industrial use. Send in the convenient coupon and you will receive a *free* copy at once.



This is FOAMGLAS®

The entire strong, rigid block is composed of millions of sealed glass bubbles. They form a continuous structure, so no air, moisture, vapor or fumes can get into or through the Foamglas block. In those closed glass cells, which contain inert air, lies the secret of the material's permanent insulating efficiency.

For additional information see our inserts in Sweet's Catalogs

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Without obligation on my part, please send me your FREE booklet on PC Foamglas Insulation, the *permanent* industrial insulation.

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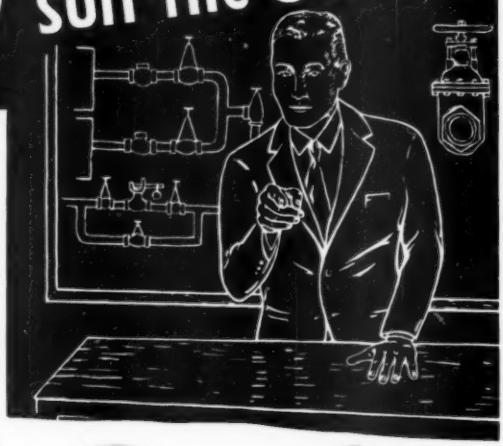
PITTSBURGH PC CORNING ® **FOAMGLAS INSULATION**

. . . when you insulate with FOAMGLAS . . . you insulate for good!

1st Lesson in Flow Control – the Valve *MUST* suit the Service



It's an established fact that there's more loss in time and money through misapplication of valves than from any other known cause.

Fortunately this can be avoided. All you need to do is standardize on the Powell Line of Valves*—because this is what you get—

I More varieties and patterns than are made by any other manufacturer of valves.

II The most complete line of Standard Designs, made of standard materials, for use wherever they fill the requirements of the service.

III Many Special Designs for Special Services.

IV Valves made in the greatest variety of materials ever used in making flow control equipment.

With such facilities at your disposal and Powell Engineers always ready to help you select the right valves, why take chances with your flow control equipment. Standardize on POWELL VALVES.

* Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.

Fig. 1847 — 200-pound Stainless Steel Swing Check Valve. Screwed-in cap and regrindable, renewable disc.

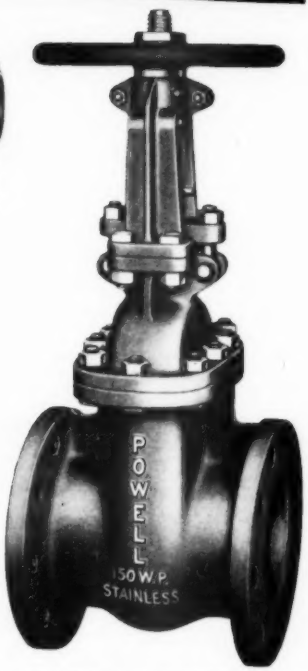


Fig. 2453-G—Large 150-pound Stainless Steel Gate Valve. Bolted flanged yoke-bonnet, outside screw rising stem and tapered solid wedge. Made in sizes 5" to 30", inclusive.

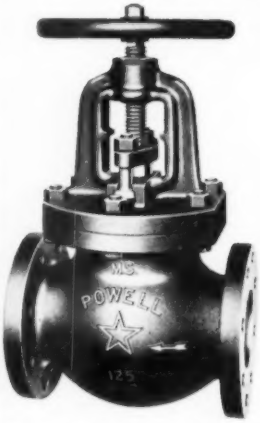


Fig. 241—125-pound Iron Body Bronze Mounted Globe Valve with outside screw rising stem, bolted flanged yoke, regrindable, renewable bronze seat and disc.

Fig. 150—150-pound Bronze Globe Valve with screwed ends, union bonnet and renewable composition disc.

Fig. 375 — 200-pound Bronze Gate Valve. Screwed ends, union bonnet, inside screw rising stem and renewable "Powellium" wear-resisting nickel-bronze disc.

The Wm. Powell Co., Cincinnati 22

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

SPECIAL TREATMENT
FOR EVERY PART

Boxed for your protection . . . labeled for your convenience

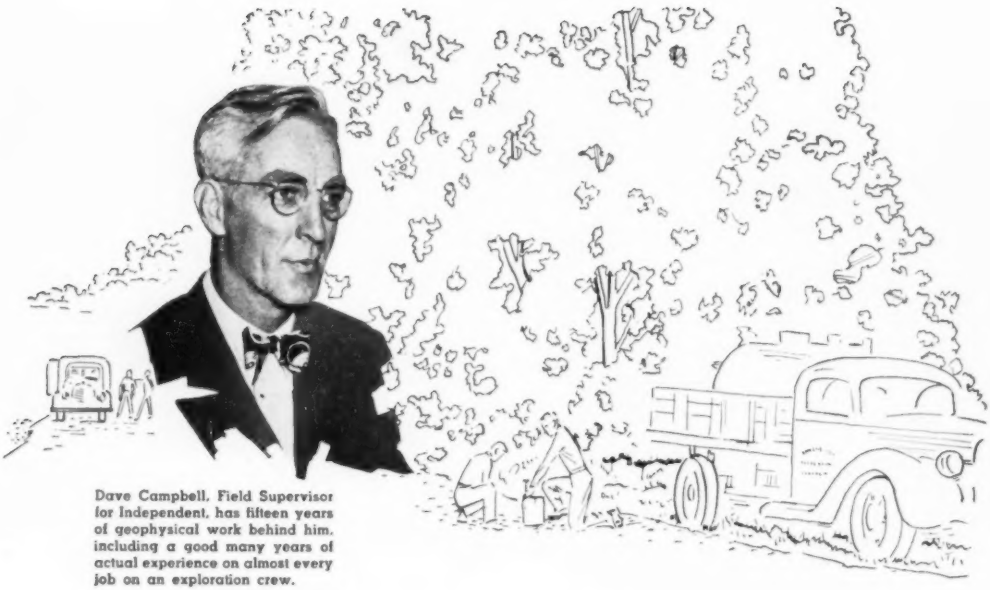
Not one, but several better alloy steels have been developed by Jeffrey in making side bars, pins and bushings for 'Devil Dog' chains (A.P.I. 3 and 4). Each part is individually heat treated and machined. Precision finish of parts eliminates the need for 'breaking-in'. Illustration shows the side bars going through the Shaker Hearth machine in our heat-treating department.

JEFFREY

ESTABLISHED 1877

JM

THE JEFFREY MANUFACTURING COMPANY, 891 [illegible] Street, Columbus 16, Ohio



Dave Campbell, Field Supervisor for Independent, has fifteen years of geophysical work behind him, including a good many years of actual experience on almost every job on an exploration crew.

Independent's 16 years of Service means surveys you can rely on

Selecting a contractor for oil exploration work is somewhat like choosing your personal physician . . . you must rely chiefly on professional experience and reputation.

When you contract with Independent Exploration Co., you enjoy the benefit of a 16-year-old reputation for getting dependable results. You will find the same satisfaction enjoyed by more than a hundred important oil producers we have served.

In the recording process nothing is left to chance. Every circuit is tested before every shot. A typical detail that helps make Independent's work efficient and reliable.

POINTING THE WAY IXC FOR THE DRILL

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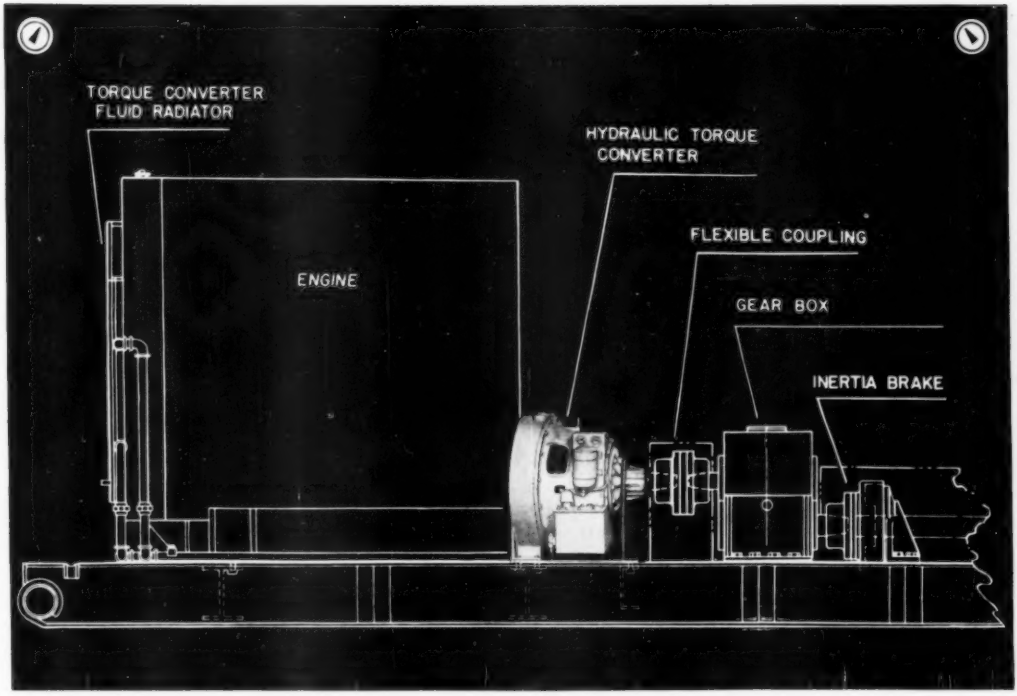


PUT THIS CONVERTER IN *YOUR* DESIGN

From among Twin Disc's three series of Hydraulic Torque Converters . . . more than 44 different models . . . there's one that you can put right into your design.

Whether it's an independent rotary drive like the sketch shown above, or a heavy-duty drilling rig involving multiple engines, you'll find Twin Disc's Hydraulic Torque Converters (Lysholm-Smith type) offer the greatest overall torque multiplication . . . extend the capacity of your rig by transmitting up to five times engine torque when that torque is needed.

Capable of transmitting from 40 to 1000 hp, Twin Disc's Hydraulic Torque Converters are standard equipment on many designs of production hoists, clean out rigs, heavy-duty drilling rigs, independent rotary table drive units, and pump drives. Why not investigate now? Write the Hydraulic Division for your copy of Engineering Bulletin 135-C. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

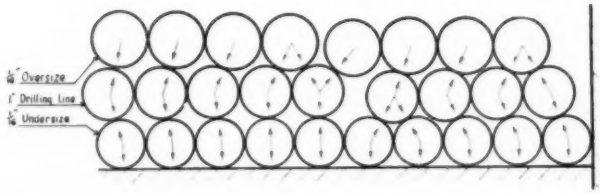
TWIN DISC
Converters can be:

- Mounted directly onto the hoist compound and driven through intermediate jackshafts.
- Independently mounted in front of hoist transmission.
- Direct-connected to engines placed at right angles to drum shaft.
- Mounted at right angles to a truck engine with right angle power take-off.

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

Flat Drum Spooling Crushes, Squeezes—Wastes—Drilling Line

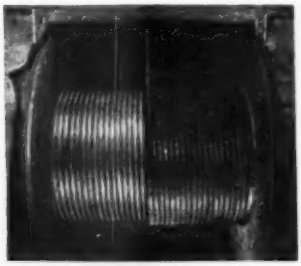
Notice how disorderly tapered wire line spools on a flat drum. The result is squeezing and cutting-in as indicated by the red arrows. These wasteful and hazardous conditions can be corrected by grooving the drum with LeBus Groove Bar and End Fillers.

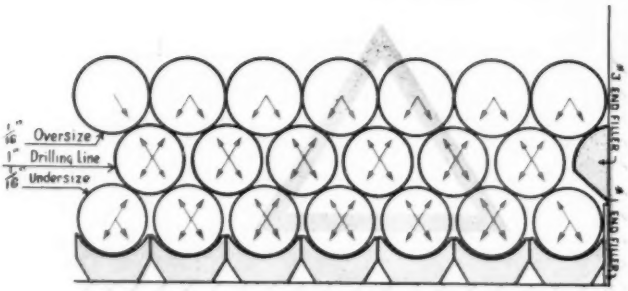


LeBus Groove Bar and End Fillers Cut Line Costs—Make Drilling Safer

Even a tapered or distorted line spools evenly and safely on a grooved drum. Notice how the loads, shown by the arrows, line up. Notice also how the wraps "pyramid". This controlled contact and even loads mean longer life and safer drilling operation.

Shown in the photograph is a drawworks drum equipped with LeBus Groove Bar and End Fillers with the first wrap half on. For complete details on Groove Bar installation and operation, including blue prints, write today. Prices and other details will be furnished if you include the make and model of your rig and line size.





Sales and Service Everywhere

No matter where you go in the oil country you'll find LeBus Groove sales and service reasonably close. You'll also find these dealers eager and anxious to make your drilling operations safer and more profitable to you. Check below. Call or write your closest supplier for complete information.

LeBus Rotary Tool Works, Inc.
P. O. Box 2352
Longview, Texas

Miether Machine Works
P. O. Box 627
Odessa, Texas

Hunt Tool Company
Corpus Christi, Texas

Flowers Machine Company
Route 1, Box 2
Alice, Texas

Wichita Engineering Co.
P. O. Box 990
Wichita Falls, Texas

Wichita Engineering Co.
Abilene, Texas

L & H Machine Works
2205 Quitman Street
Houston, Texas

Parker Welding Works
910 West Brown Street
Pampa, Texas

Red Fox Machine Works
New Iberia
Louisiana

Young & Elkins Machine Works
P. O. Box 404
Harvey, Louisiana

Reagan Tool Company
P. O. Box 594
Natchez, Mississippi

C & W Machine Works
P. O. Box 12
Great Bend, Kansas

M-C-M Machine Works
P. O. Box 4583
Oklahoma City 9, Okla.

S. R. Bowen Co.
Santa Fe Springs, Calif.

Western Oil Tool Co.
Casper
Wyo.

C & E Machine Co.
Rangely
Colo.

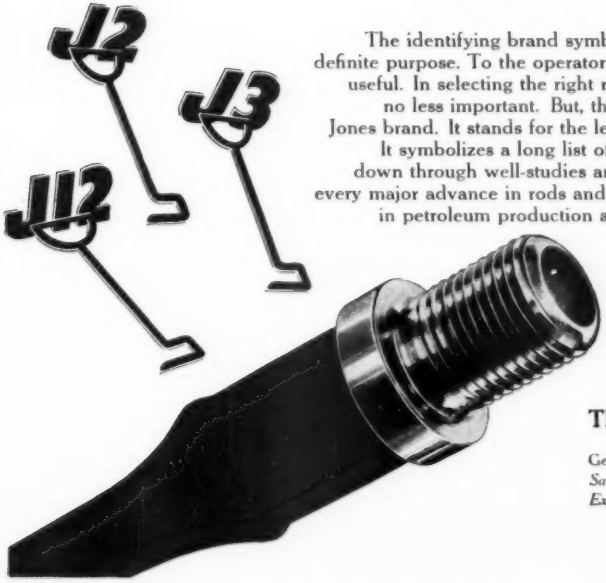
Hunt Export Company, Room 2303, 19 Rector Street, New York City, N. Y.

LEBUS

LeBus Rotary Tool Wks., Inc.

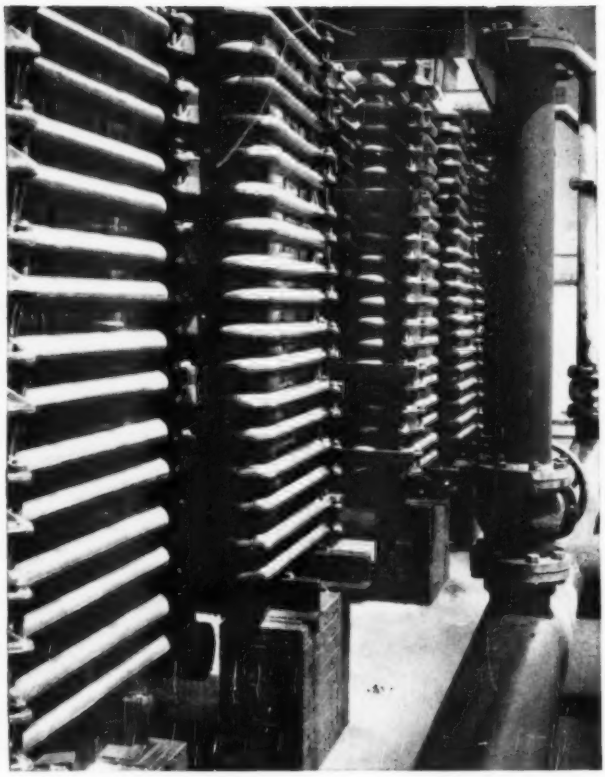
P. O. Box 2352 Longview, Texas

A BRAND WITH A MEANING...



The identifying brand symbols on each Jones sucker rod serve a definite purpose. To the operator who keeps rod records, they are especially useful. In selecting the right rods to run in a particular well, they are no less important. But, there is a far more important meaning to the Jones brand. It stands for the leadership of more than half a century. It symbolizes a long list of "firsts" from the first all-metal sucker rod down through well-studies and research and includes practically every major advance in rods and their use. It is instantly recognized by those in petroleum production as a mark of quality in sucker rods.

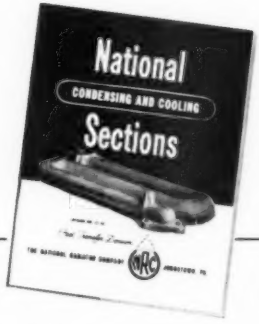
THE S. M. JONES COMPANY
(Subsidiary of Buffalo Bolt Company)
General Office and Factory: TOLEDO, OHIO
Sales Office: Kennedy Building, Tulsa, Okla.
Export Sales Office: Buffalo International Corp.
50 Church Street, N. Y. C.



FOR

Performance...

NATIONAL CAST IRON CONDENSING AND COOLING SECTIONS



EFFICIENT Integrally cast longitudinal fins interrupted by swirl strips increase heat transfer rate, reduce pressure losses. External design promotes unrestricted flow of water with minimum splashing. Far less water is required. In submerged installations, National Sections collect less foreign matter, give high performance longer.

DURABLE Gray cast iron of exceptionally high quality and close grain goes into National Sections. Corrosion resistance under varied and severe conditions is high . . . heavy scaling and growths greatly reduced. Turns reinforced against corrosion. No "battery action" in handling electrolytes.

COMPACT National Sections require far less space for a given amount of heat transfer. In certain installations, National Sections require only one-third the space needed by competitive equipment.

ACCESSIBLE Component parallel stacks of National Sections can be installed, serviced, dismantled easily. Support lugs are cast integrally. Sections are self-aligning, self-supporting no auxiliary bracing needed.

NEW CATALOG

Installation and Engineering Data

Catalog No. HT-20, just off the presses, gives you full information about the use of National Sections in varied applications. Design features and physical characteristics are explained in detail. Typical installations are pictured and described.

Catalog includes very complete data and curves for pressure drop and heat transfer and should prove a welcome addition to the process engineer's file. Detail drawings of fittings and accessories specially designed for National Sections are shown along with dimensional data. A simplified data sheet makes it easy for you to request specific engineering information or service.

Write for your copy today.
No obligation of course.

NRC

HEAT TRANSFER DIVISION
THE NATIONAL RADIATOR COMPANY
JOHNSTOWN, PENNSYLVANIA

FOR THE TALL JOBS

built for the job

When it comes to tallness, the giraffe has all other living animals far outclassed . . . just as Kenworth trucks are in a class by themselves when it comes to accomplishing those tall jobs — taking those tough assignments in stride, getting the job done against odds. Men who operate Kenworth trucks know they can eliminate waste and assure themselves greater profits by specifying trucks built for the job. Custom engineering means efficiency. Kenworth is interested in learning about your specialized transportation problems . . . in proving to you that *there's more* **WORTH** *in* **KENWORTH.**

KENWORTH

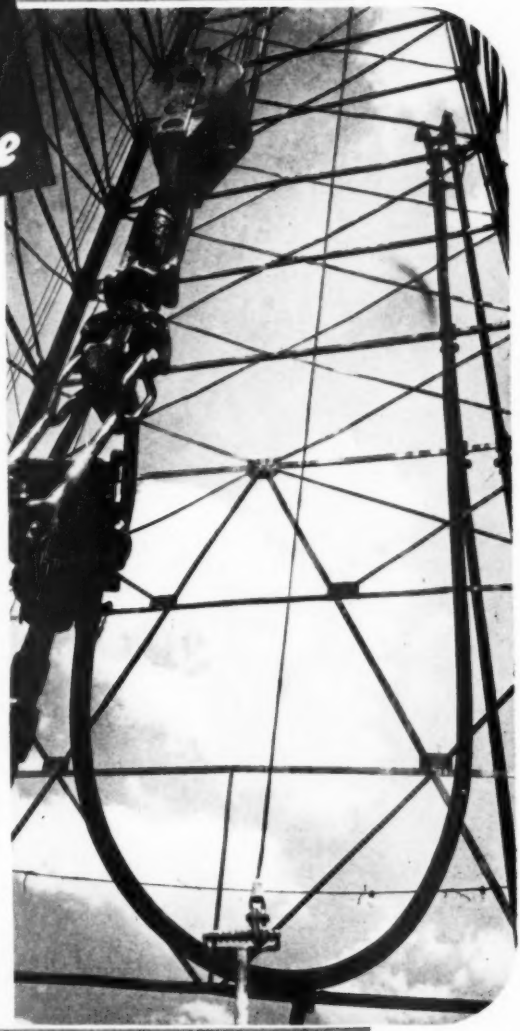
TRUCKS ★ BUSES

FACTORY AND HOME OFFICE: SEATTLE, U. S. A. DISTRIBUTORS IN THE UNITED STATES AND MOST FOREIGN COUNTRIES

On one of the longest non-stop operations in the country, this and another Kenworth Model 521 transport oil field equipment from Houston, Texas, to the Canadian Border, at Coutts, Alberta, round trip about 4,600 miles. Hill & Hill Truck Lines, Inc., report operating costs with the Kenworths are 66 per cent less than with smaller units, and time saved is approximately 40 hours per round trip.

THREE practical hose "kinks" for users of

GOODALL FLEXO LONG LIFE Rotary Hose



Years of experience with all kinds of rotary hose has proved to drilling contractors and oil companies all over the world, that Goodall Flexo Rotary Hose has earned the name "long life." Here are three ways to lengthen that life — to insure even longer, more useful service from your Goodall Flexo Rotary Hose.

- In the event that the hose ruptures behind the coupling — the most common cause for rotary hose replacement — it can easily be repaired by setting the Barney coupling in good hose. The loss in length may be as little as 18 inches. This inexpensive repair job may often save the hose several times before it finally becomes too short.
- If damage occurs near the center of the hose (or if the usable hose is too short), have the couplings reset in short lengths for use as vibrator hose at a considerable saving.
- Then, when the hose is completely used up, the Barney Couplings still have a trade-in value! That important saving is just another reason why Goodall is the first choice among drilling contractors everywhere.

Don't forget the Goodall Service Department — the only complete repair department devoted exclusively to rotary hose!

To get even longer service from your Goodall Rotary Hose, use a swing joint between the standpipe and hose. The extra long service you get from the swing joint installation will reduce hose costs almost to the vanishing point.

GOODALL RUBBER COMPANY
TRENTON, N. J.

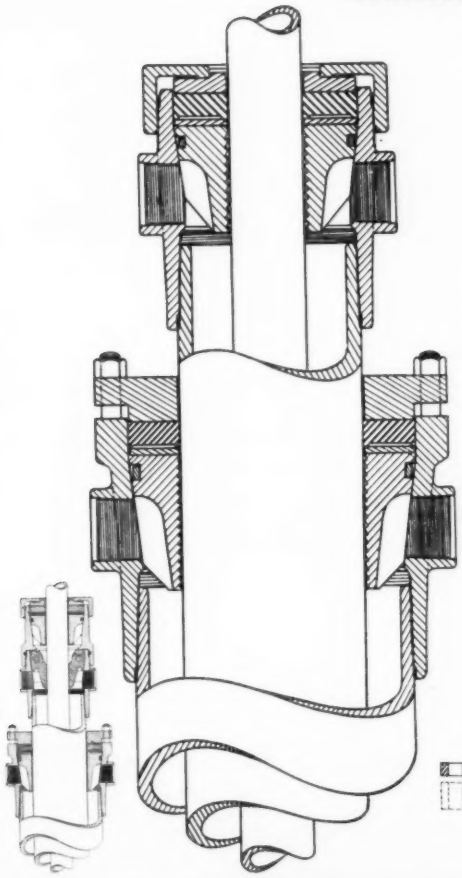
GOODALL RUBBER COMPANY OF TEXAS: Houston, Texas
GOODALL RUBBER COMPANY OF CALIFORNIA: San Francisco, Los Angeles, Seattle, Salt Lake City
GOODALL RUBBER COMPANY: St. Paul, Minn.
EXPORT: Goodall Rubber Company, Trenton, N. J.
DISTRIBUTORS: Texas and Louisiana — Houston Oil Field Material Co. Wilson Supply Co., Oklahoma — Iverson Supply Company

HIGH QUALITY . . . LOW COST IN FORGED STEEL HEADS

The RECTOR REDHEAD

TYPE R

CASING AND TUBING HEADS



Designed especially for low pressure wells, by the industry's leading manufacturer of high pressure heads, the Rector REDHEAD Type "R" Casing and Tubing Head, gives you these oustanding advantages:

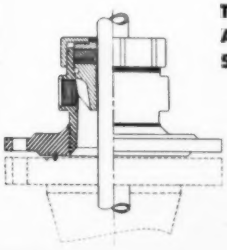
1. Rugged, forged steel construction.
2. Interchangeable stripper and slips.
3. Three segment type, "ribbed" construction slips.
4. Full Opening Body.
5. Minimum height.
6. Highest safety.
7. Low cost . . . highest efficiency.
8. Oil and gas resistant packing ring.

The body of these forged steel heads are ruggedly constructed, having greater thickness and weight than any casing or tubing to which they would be attached. The ribbed construction slips permit full flow to outlets. The casing head pack-off consists of a special oil and gas resistant ring, resting on a split junk ring on top of the slips, which seals off when the split packing gland is tightened down on top of the head by six stud bolts. The same pack-off is used in the tubing head, except that a screw down cap is used in place of the bolted packing gland.

The Type "R" Tubing Head can be furnished with a slip bowl adapter to carry slips, packing and gland, so that a stripper can be carried in the head body when desirable. Stripper and slips are interchangeable so that two strippers can be used if desired.

Type "R" Casing and Tubing Heads are adaptable to a wide range of installation preferences, including a threaded hanger for use with hydraulic and electric pumps.

Write for new bulletin giving complete construction details of the new Type R Redhead.



TYPE "R" CASING AND TUBING HEADS ARE STOCKED AND SOLD BY SUPPLY STORES.

RECTOR WELL EQUIPMENT CO., INC.
Fort Worth, Texas.

Fort Worth Plant.....1100 N. Commerce St.
Houston Plant.....2215 Commerce St.
Export Sales: Champion and Smith, 10 Rockefeller Plaza, New York 20, N. Y.; 617 S. Olive St., Los Angeles, Calif.; Esperson Bldg., Houston, Texas.

REPRESENTATIVES IN ALL ACTIVE FIELDS

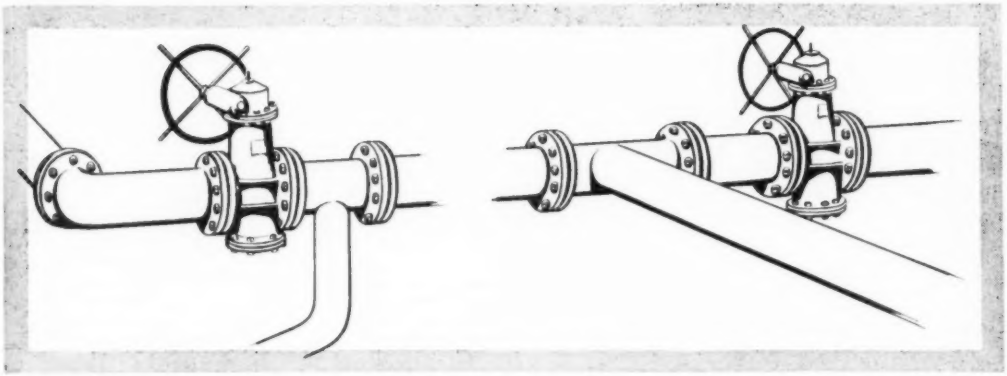
RECTOR

RECTORHEAD

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

MAKING THE OIL INDUSTRY SAFER!

No . . . Your WATER SUPPLY LINES are not actually broken this way . . .



Loss of carrying capacity in water supply systems is costing YOU many dollars every year.

The need for additional pumps in many cases is due to friction loss—leakage—obsolescence — incrustration — unrecorded take-off—increased demand—all of which cause this costly loss of carrying capacity.

Data collected by research groups over the past ten years is so accurate that, given the source of water supply and the age of the pipe, a reasonably accurate estimate of loss of carrying capacity can be made without an examination.

The Pittsburgh Pipe Cleaner Company Engineering Department has specially trained hydraulic engineers to make these estimates for you. Write today.

And NOW—agents for the Gates Engineering Co., Offering expert application of the following plastic coatings to reduce corrosion: GACO-NEOPRENE — GACO-NEOFLEX — GACO-NITRO-COTE — GACO-DURA-FILM — GACO-"316."

PITTSBURGH PIPE CLEANER COMPANY

133 Dahlem St., Pittsburgh 6, Pa.

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Cut Down on Your Operating Costs—*Demand*

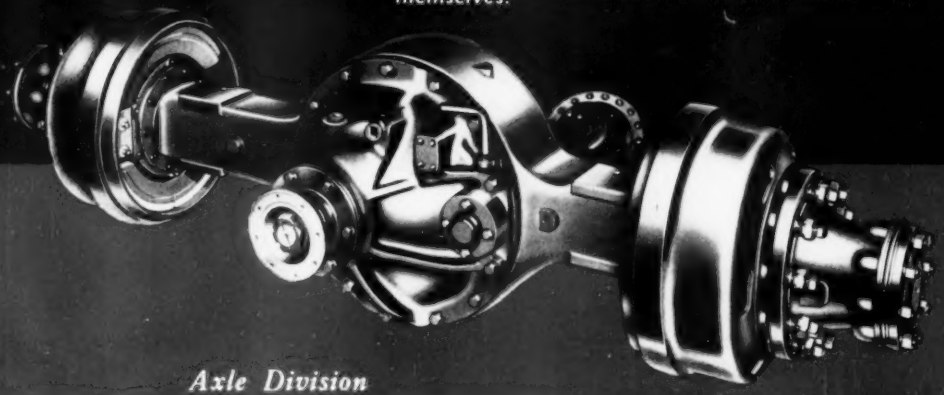
EATON

2-Speed Truck

AXLES

To cost-conscious truck operators, Eaton 2-Speed Axles mean faster trips, reduced vehicle operating and maintenance expenses. These advantages are possible because Eaton 2-Speed Axles double the conventional number of gear ratios, thus enabling drivers to use the RIGHT ratio for every operating condition—starting out under full load, climbing grades, high-balling, quick shifting in traffic. As a result, vital truck parts are not overstressed, engines are permitted to run at efficient speeds, cutting gas and oil consumption and minimizing engine wear. Long life for the axle is assured by rugged construction and exclusive Eaton features. Ask your truck dealer to prove that Eaton Axles *more than pay for themselves.*

More Than a Million Eaton 2-Speed Axles in Trucks Today



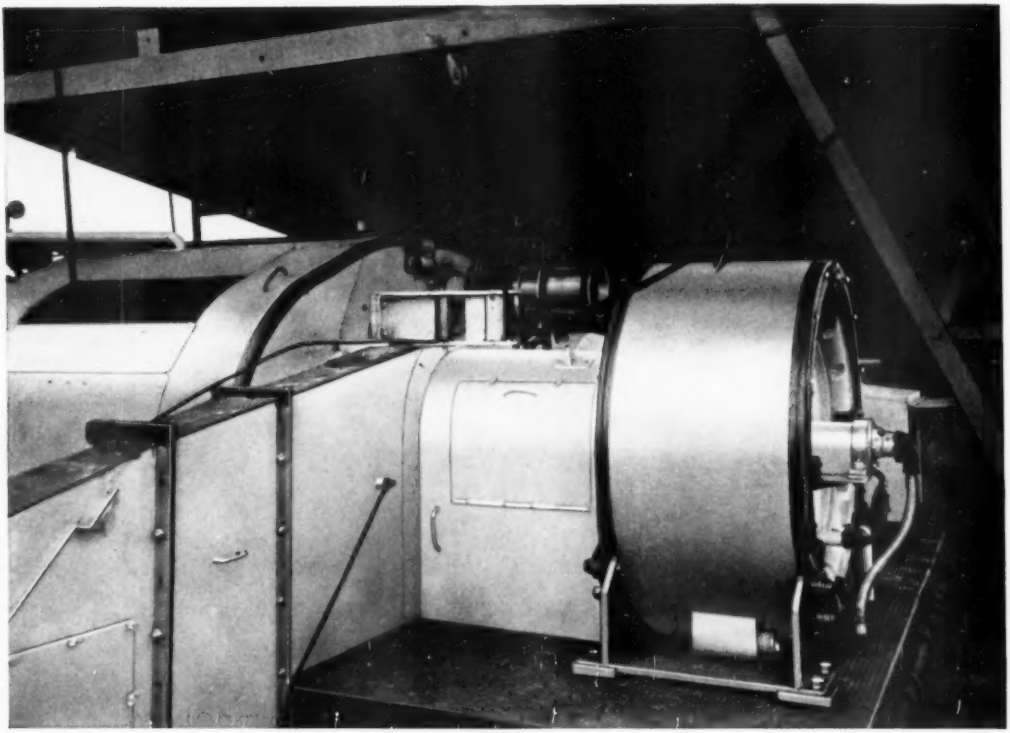
Axle Division

EATON MANUFACTURING COMPANY

CLEVELAND, OHIO

EATON

PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS • SPRINGTITE SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS



Set Slips on Heaviest Strings Without Brake Friction or Wear

The Dynamatic Drawworks Brake can be used while setting slips on the heaviest strings of pipe or casing without use of the friction brake. It is completely magnetic; involves no brake blocks or bands. Nothing to wear out.

- Simple as a light circuit.
- Precision finger-tip control from driller's position.
- High torque at low speeds.
- Operates on ordinary light plant current.
- Proven in all major fields, including off-shore drilling.
- Readily applied to all rigs—large or small. Can be installed in the field.

Available from drawworks manufacturers and their distributors. Write for illustrated literature.

DYNAMATIC
ELECTRO-MAGNETIC

DRAWWORKS BRAKES

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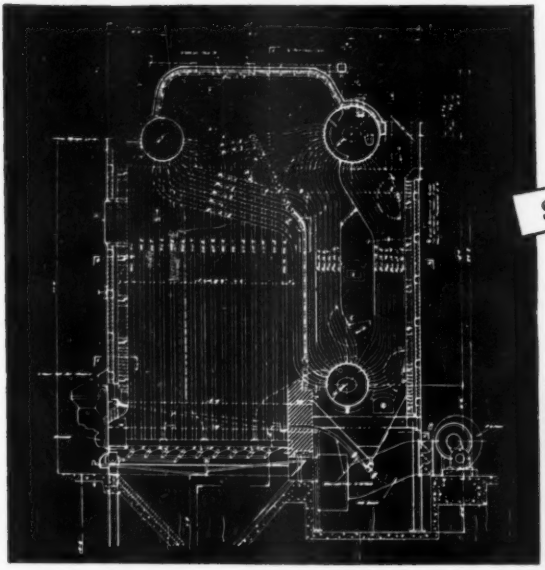
EATON

DYNAMATIC DIVISION KENOSHA, WISCONSIN

EATON MANUFACTURING COMPANY, CLEVELAND, OHIO

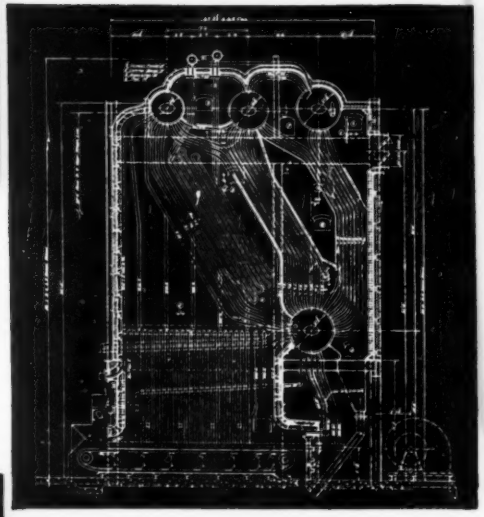
Quick Steaming at all Ratings!



Carry high overloads with high efficiency

SPECIFY Vogt

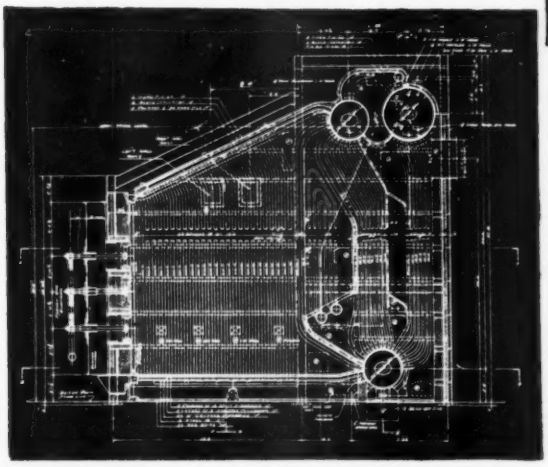
STEAM GENERATING UNITS



CLASS VL Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.



Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

BRANCH OFFICES:
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BWH
DEPENDABLE RUGGEDNESS
BOSTON WOVEN HOSE & RUBBER CO.
CONCORD
STEAM #10
BOSTON, MASS.
BWH
1. Tough, long-wearing, abrasion-resistant cover.
2. Asbestos braid insures maximum cover adhesion, and includes NEW type static conducting wire.
3. High-tensile steel wire for strength, for safety.
4. Heat & oil resistant tube.

SAFE, FLEXIBLE BWH CONCORD #10

WHIPS REFINERY STEAM HOSE PROBLEMS

Here's the much talked-of new CONCORD #10 WIRE BRAID STEAM HOSE . . . the hose that's first choice in more and more refineries, as experience shows its ability to handle rugged jobs and high pressures.

Flash explosions can't happen with this latest BWH armored hose. Little warning whispers of steam start to seep out when replacement is necessary. Bursts that formerly caused serious injuries and production interruptions are out of the picture when CONCORD #10 is used.

The heart of this hose is the same dependably strong rubber tube famed for extra service in BWH BULL DOG Steam Hose. It's muscled with braids of high-tensile steel wire, resistant to heat and pressure. It contains no duck to char, therefore lasts longer.

For cleaning, for fire protective service, everywhere there's need for steam hose to withstand working pressures up to 200 lbs., CONCORD #10 is highly recommended. Specify it next time you're in the market for wire braid hose!

HAVE YOU A JOB WHERE STAMINA COUNTS? Bring us your toughest problems. We're specialists in solving them. Consult The Happy Company, Tulsa, Oklahoma.

The HAPPY COMPANY
Formerly HAPPY BELTING COMPANY
TULSA, OKLAHOMA

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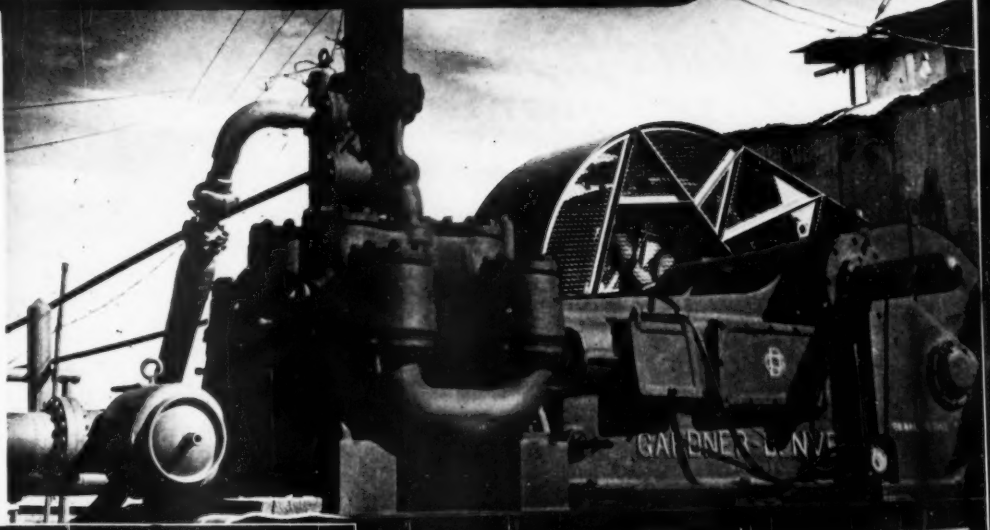
Another Quality Product of

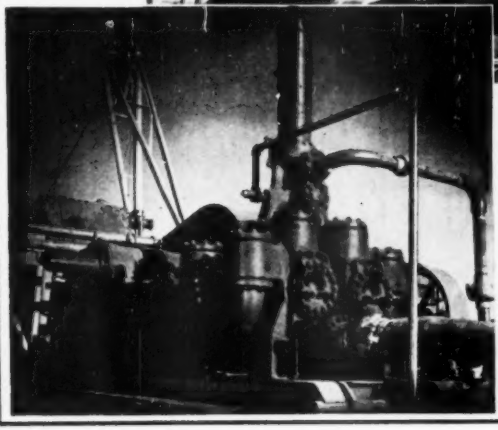
BOSTON WOVEN HOSE & RUBBER COMPANY

Distributors in all principal cities

PLANT: CAMBRIDGE, MASS., U. S. A. • P. O. BOX 1071, BOSTON 3, MASS.

POWER PLUS PROTECTION





GARDNER-DENVER

TYPE "FX"

POWER SLUSH PUMPS

- Continuous tooth-type Herringbone main gear and drop forged pinion—*long, trouble-free operation.*
- Automatic, controlled lubrication to power and working parts—*grease packed Jack-shaft roller bearings have pressure gun connections outside the frame.*
- Divided fluid end construction—cast of GarDurloy Alloy—*developed especially for mud pumps.*
- Rugged, one-piece double wall main frame—*provides greater resistance to shock loads.*
- These, and other famous Gardner-Denver features, *mean protection—from mud and water . . . from shock . . . from overloads . . . from friction.*

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THE CONTINENTAL SUPPLY COMPANY, *General Offices:* DALLAS, TEXAS

Export Division: 30 Rockefeller Plaza, New York, N. Y.

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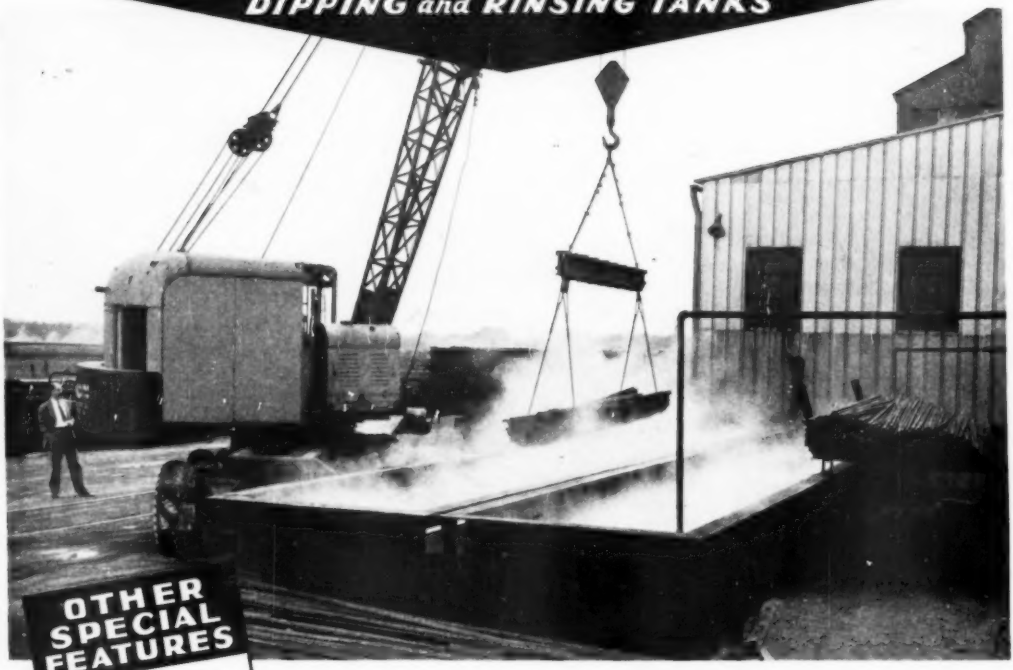
You Should Know

how Your pipe protection is applied!

THE FIRST IMPORTANT STEP

is the HILL, HUBBELL Caustic DIPPING and RINSING TANKS



OTHER SPECIAL FEATURES

- ANGULAR GRIT BLAST CLEANING
- WARMING AND DRYING ROOMS
- MECHANICALLY AGITATED KETTLES
- COATING and WRAPPING MACHINES FOR PIPE FROM ¾" NOMINAL TO 26" O. D.
- GONDOLA CAR LOADING American Railway Assn. approved

CAUSTIC DIPPING AND RINSING TANKS for the removal of oil and grease from your pipe and angular grit blasting by the **ROTO-BLAST** process, makes doubly sure that your pipe is absolutely cleaned and prepared to receive the coating-and-wrapping that you specify.

Your factory applied pipe protection by **HILL, HUBBELL** is processed with the exacting care, that comes with 25 years of experience by skilled men equipped with the latest machinery for producing the BEST coating-and-wrapping job without additional cost to you.

Hill, Hubbell and Company

Division of GENERAL PAINT CORPORATION

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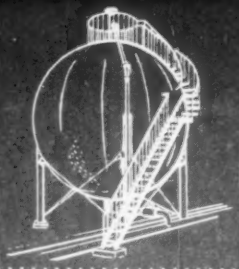

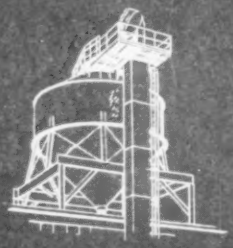

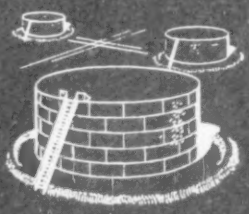

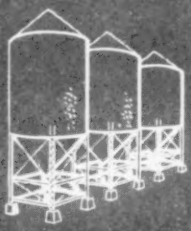

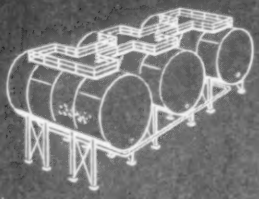

How to Solve

YOUR MATERIALS STORAGE PROBLEM!

PITTSBURGH · DES MOINES Research

develop the answers for you

Finding the *right answers* to questions of efficient materials storage is a primary Pittsburgh-Des Moines activity.

Our research engineers, and our Chemical Storage Fellowship at Mellon Institute for Industrial Research, conduct a continuous program of study on storage problems from many fields, which is translated into better design, materials and methods by our fabricating divisions for the customer's benefit.

We will be glad to help with your own storage problem, if you will send us an outline of the factors involved.

PITTSBURGH · DES MOINES STEEL CO.

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WALTER *presents a* NEW VERSATILE, POWERFUL TRUCK !

- Handles many jobs
- Goes anywhere— on or off the road

★ **Used as a winch truck**—lifts and carries 10 ton loads or drags 20-ton loads.

★ **Used as a tractor**—hauls 25-ton capacity pole or semi-trailers.

THIS new Walter Tractor Truck is equipped with demountable winch equipment and fifth wheel It can be used interchangeably for lifting, carrying, dragging or hauling of big loads, in the severest running conditions

The big feature is the ability of this Walter Tractor Truck to haul through conditions that stop other trucks—sand, mud, soft dirt, snow, steep grades This is possible because of the exclusive Walter Four Point Positive Drive which assures 100% positive traction in four driving wheels There is no wheel slipping or spinning, no stalling of loads

You have a choice of gasoline engines from 185 to 290 hp., or 260 hp diesel engine Extra large diameter 16.00-24 low pressure tires provide maximum rolling ability and high ground clearance These units meet requirements of 18,000 lb axle loading on the highway Winch equipment, wheelbase and other details may be modified to meet your requirements

WRITE TODAY for full details on this new Walter Tractor Truck-Winch Hauler.

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4-POINT POSITIVE DRIVE
TRACTOR TRUCKS

WALTER MOTOR TRUCK CO.
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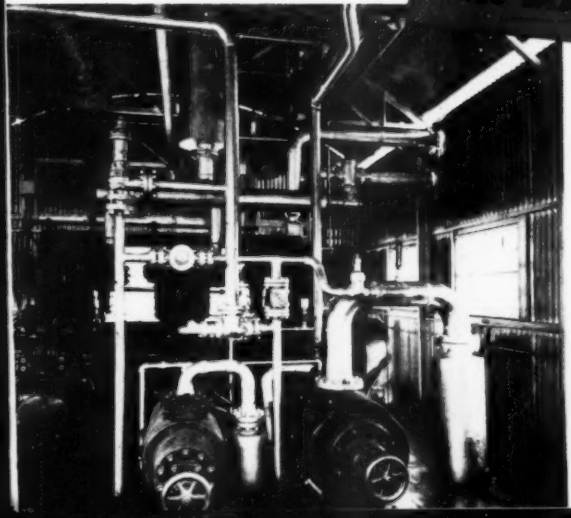
ANOTHER NOTABLE "FIRST" BY

Levingston

Above—Compressor Barge being towed to location.

Below—Interior view of Barge showing compressor.



Here is another example of Levingston's leadership in the field of specialized marine equipment for the petroleum industry.

Levingston

SHIPBUILDING COMPANY

ORANGE, TEXAS

Marmon-Herrington

ALL-WHEEL-DRIVE

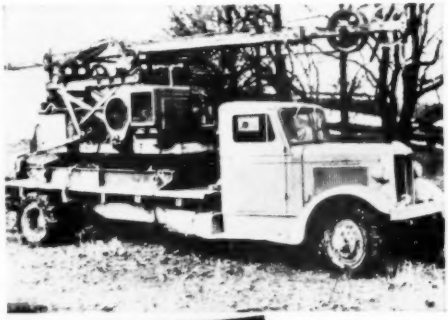
wherever the going is tough

Oil men the world over know there are no trucks on earth to compare with Marmon-Herrington *All-Wheel-Drives*—not when there are really tough trucking jobs to be done.

Live power and traction on all wheels is the answer. With front wheels pulling, rear wheels pushing, these great trucks have the sure-footed tractive power of crawler tractors—plus truly amazing speed and maneuverability. Here are trucks that carry on where those of conventional drive stop—trucks capable of transporting peak payloads through deep mud, sand and snow, up steep hills and mountain grades—speedily, easily, economically.

In all, there are 22 *All-Wheel-Drive* models in the Marmon-Herrington line—a model with the right size, power and capacity for every conceivable oilfield need. Wheelbases range from 110″ to 220″—gross vehicle weights from 5,300 pounds to 42,000 pounds.

For a demonstration of almost unbelievable performance-ability, see your Marmon-Herrington *All-Wheel-Drive* Truck dealer. There's one near you.



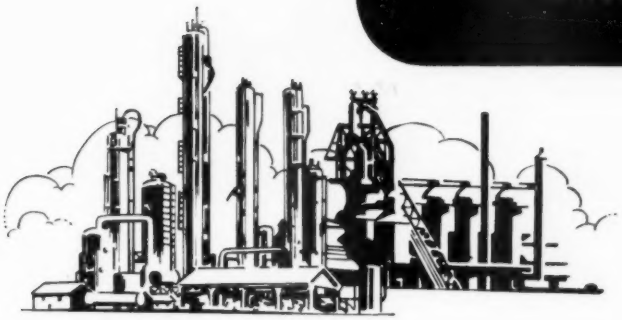
MARMON-HERRINGTON COMPANY, INCORPORATED

MARMON-HERRINGTON

Indianapolis 7, Indiana

FIRST CHOICE

For Heavy Production at Lowest Operation Cost



For heavy duty water production at the very lowest operation cost, the answer is Layne Well Water Systems. These systems are engineered and built for producing large quantities of water and are always equipped with the famous, high efficiency Layne Vertical Turbine Pumps. Such a combination not only immediately lowers water cost but keeps it at a very minimum for years to come.

Layne Vertical Turbine Pumps are available in sizes from 40 to 16,000 gallons per minute with electric motor, engine or steam turbine drives.

The basic reasons of why this water producing equipment operates at such low cost, includes such desirable factors as the most advanced engineering features, extra high grade quality of all materials used, the most skillful precision work in manufacturing and definitely superior construction procedure in the well itself.

In all cases where large volumes of ground water are required for cooling, general refinery purposes, pumping station, etc., Layne Well Water Systems have long been first choice. They last longer under heavy production, operate more smoothly and are most dependable in continuous use. They are built to fulfill the water needs of plants of all sizes.

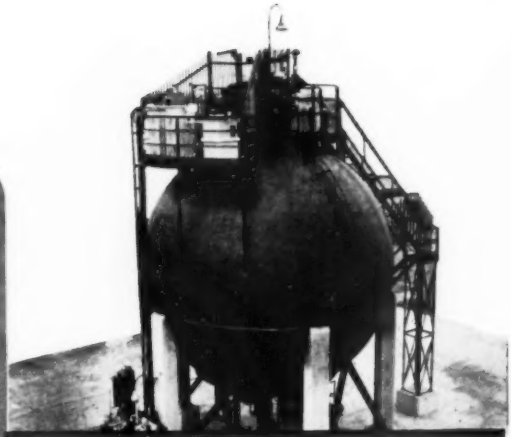
Layne offers a complete service in Well Water System construction which includes everything from the planning, drilling of the wells, installing the pumps, thorough testing and final delivery of the units in full production. This service has many desirable features, such as the saving of time, elimination of divided responsibility and the chances of unmatched pumping equipment. For further facts, catalogs, etc., address

LAYNE

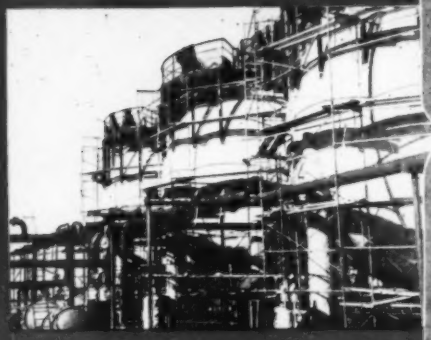
LAYNE & BOWLER, INC.
GENERAL OFFICES: MEMPHIS 8, TENN.

WELL WATER SYSTEMS

AFFILIATED COMPANIES — Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Pacific, Inc., Seattle, Wash. ★ Layne-Texas Co., Houston, Texas ★ Layne-Western Co., Kansas City ★ Layne-Minnesota Co., Minneapolis, Minn. ★ International Water Corporation, Pittsburgh, Pa. ★ International Water Supply, Ltd., London, Ontario, Canada ★ Layne-Hispano Americana, S. A., Mexico, D. F.



These 3 facts are worthy of serious consideration by any refiner who is planning on increasing the efficiency of his desalting procedure.



1 More **PETRECO** Electric Desalters are now in use than ever before.

2 More **PETRECO** Electric Desalters are under construction than ever before.

3 Only **PETRECO** offers complete desalting service personnel and facilities.

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SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

PR-49-5

CHECK YOUR USES HERE

DRILLING RIGS

- ☐ Water supply to rigs
- ☐ Conditioning drilling mud
- ☐ Drinking water supply
- ☐ Fire protection
- ☐ Washing down drill pipe, etc.
- ☐ Water supply for cementing, etc.
- ☐ Transferring mud between pits
- ☐ Dewatering around rigs
- ☐ Dewatering slush pits

GEOPHYSICAL AND EXPLORATION WORK

- ☐ Jetting shot holes
- ☐ Drilling test holes
- ☐ Filling water tanks on seismograph trucks

PRODUCTION

- ☐ Residue from sumps inside fire walls
- ☐ Oiling down lease roads
- ☐ Tank bottoms to slush pits for disposal
- ☐ Filling tank trucks with water for initial treaters, indirect heaters, radiators, etc.
- ☐ Transferring tanks (leaky tanks, bad oil; for repairs, cleaning, etc.
- ☐ Transferring salt water
- ☐ Cleaning up oil lease: line breaks, tank leakage
- ☐ Circulating tank bottoms through treaters
- ☐ Circulating bad tanks through treaters
- ☐ Pumping from tank or treater to slush pit
- ☐ Driving chemical feed pump
- ☐ Draining treater for cleaning
- ☐ Domestic service around lease houses
- ☐ Cleaning B.S.&W. from tanks (heavy)
- ☐ Cleaning B.S.&W. from tanks (light)

PIPELINE OPERATIONS AND MAINTENANCE

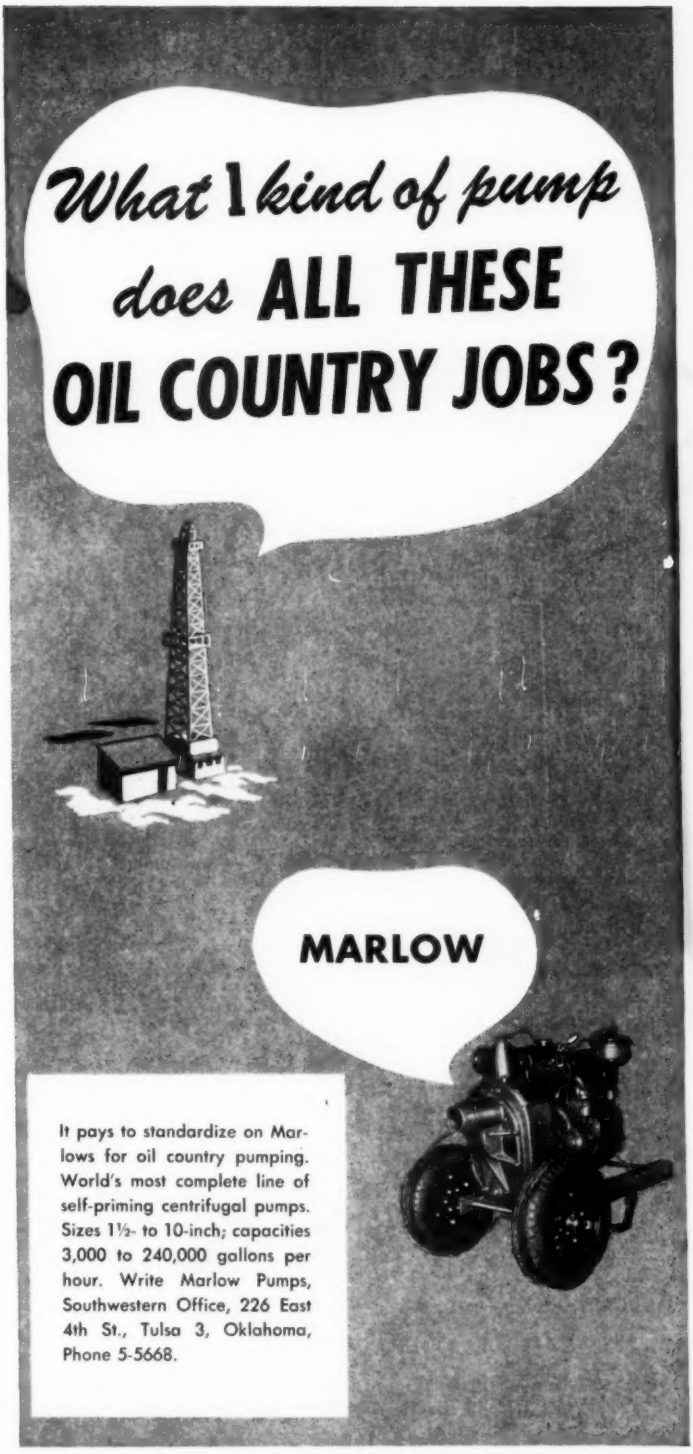
- ☐ Cleaning up oil lease
- ☐ Pumping out sumps
- ☐ Removing water from pump houses
- ☐ Dewatering for repairs
- ☐ Salvaging oil in event of line break
- ☐ Transferring tanks in case of leaks
- ☐ Gathering systems (lower pressures)

PIPELINE CONSTRUCTION

- ☐ Dewatering
- ☐ Water supply to equipment
- ☐ Washing down equipment
- ☐ Pumping station foundations

REFINERIES

- ☐ Pumping cooling water
- ☐ Pumping out sumps
- ☐ Water transfer
- ☐ General waste pit pumping


What kind of pump does ALL THESE OIL COUNTRY JOBS?
MARLOW
It pays to standardize on Marlows for oil country pumping. World's most complete line of self-priming centrifugal pumps. Sizes 1½- to 10-inch; capacities 3,000 to 240,000 gallons per hour. Write Marlow Pumps, Southwestern Office, 226 East 4th St., Tulsa 3, Oklahoma, Phone 5-5668.

Uniform
★ Makes up fast
★ Resists collapse
★ Resists pull-out
INSPECTED INSIDE
AND OUT
Republic Electric Weld Casing and Tubing are made from flat-rolled steel, both sides of which are inspected. Thus, the surface which becomes the inside wall is free from hidden defects.

Strength Means Extra Life for REPUBLIC *Electric Weld* CASING

● Recent salvage operations have shown that some oil country steel tubular goods, put in service as far back as twenty years ago, still are 90% usable! Much of the pipe recovered in such salvage searches has been Republic Electric Weld Casing . . . demonstrating anew how its uniformly high strength means extra life and an extra margin of hole protection.

Largely responsible for this uniformly high strength is the advanced Electric Weld process by which Republic Casing and Tubing are manufactured. Cold forming, full normalizing and cold sizing all are integral steps. They help produce a tubular steel wall of high ductility, with uniform grain structure and high yield point . . . with the weld fully as strong as the rest of the wall.

Its high yield strength combines with uniform roundness to give Republic Electric Weld Casing extra resistance to collapse. Since the wall is uniformly round and thick, plenty of tough steel is left under thread roots *all around the pipe*—additional protection against disastrous and expensive pull-outs.

It will pay you well—in long-time protection and time saved in make-up—to insist that Republic Electric Weld Casing and Tubing be delivered to your rigs.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

REPUBLIC *Electric Weld*
NORMALIZED CASING AND TUBING

REPUBLIC STEEL

Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Upset Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes

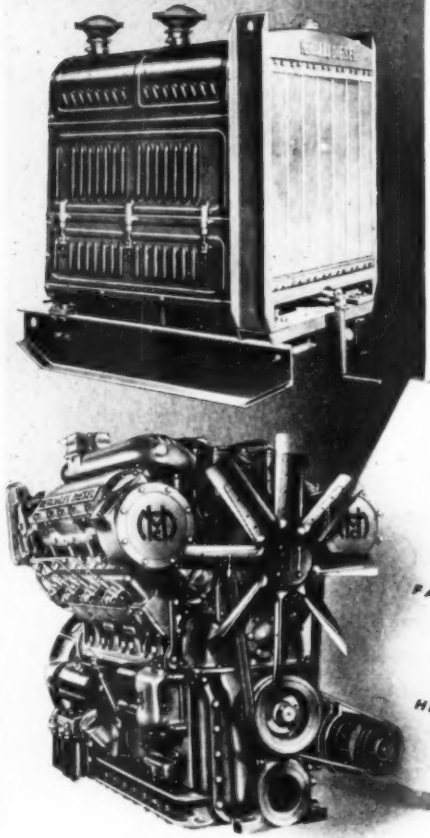
To better serve the OIL INDUSTRY

with

DEPENDABLE

HERCULES

POWER UNITS - ENGINES AND PARTS



HERCULES MOTORS CORPORATION
CANTON 2, OHIO, U. S. A.
Announces the opening of a
FACTORY SALES AND SERVICE BRANCH
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June First, Nineteen Hundred Forty-Nine
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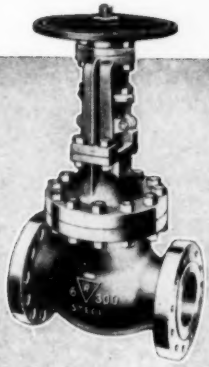
Where adequate stocks of Hercules Power Units, Engines and parts will be maintained.

HERCULES MOTORS CORPORATION • CANTON 9, OHIO, U. S. A.

"VALVE MEN" LIKE R-P&C VALVES



Men who really know valves—know where to look for those details of design and construction that insure top performance—have a lot of respect for Reading-Pratt & Cady.

***An R-P & C valve** must be more than just an assembly of machined parts. It has work to do. R-P & C feels the responsibility for that work being done faithfully.*

Consider your R-P & C distributor as your "valve man"—a responsible source for bronze, iron and steel gate, globe, angle and check valves—Bar Stock valves—iron cocks—Lubrotite gate valves—cast steel fittings.

ACCO

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READING-PRATT & CADY DIVISION
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HIGHLY PORTABLE POWER

FOR SERVICING or WORK-OVER DUTY

Premier Well Service, Inc., Houston, Texas, operates this drilling rig powered with two Waukesha 6-NKU units. Their units combine great power with a high degree of portability. That's why so many operators throughout the oil fields use them, especially for portable servicing and work-over jobs. Operating here on natural gas each Waukesha 6-NKU is equipped with a 4-cylinder Waukesha ICK gasoline starting engine, and a belt-driven air compressor, directly behind the radiator, for operation of air clutches and controls on the rig transmission.

Waukesha Model 6-NKU unit has a box base and separate radiator. Its 6-cylinder, 7-in. x 8½-in., 1962 cu. in. engine operates on 1000 Btu. gas or butane and develops peak of 225 hp. for momentary overload, and 173 hp. continuously at 1050 rpm. Its renewable wet type cylinder sleeves, positive drive water pump, overhead valves, 7-bearing crankshaft, full pressure oiling, precision bearings are detailed in Bulletins 1136 and 1122.

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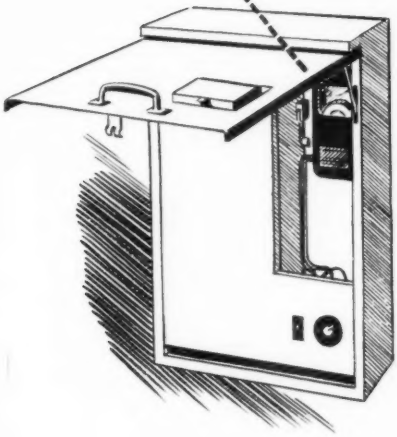
WAUKESHA
OIL FIELD POWER

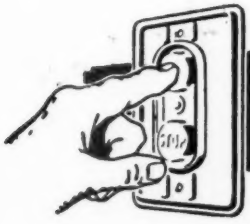
"SMARTEST THING the Company ever did!"



Yessir, it was a good day for me — and for the Company — when the lease was electrified. I looked after the lease alone while the wells were flowing. Now that they're pumping, electric power enables me to get the production by myself.

I can really rely on that time clock — I simply set the hours I want the wells "on" and "off" and they pump that way — month after month.

I see the power bills, too. They prove definitely that it's smart . . . and ***economical*** . . . to switch to electric power.



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Dependable Service

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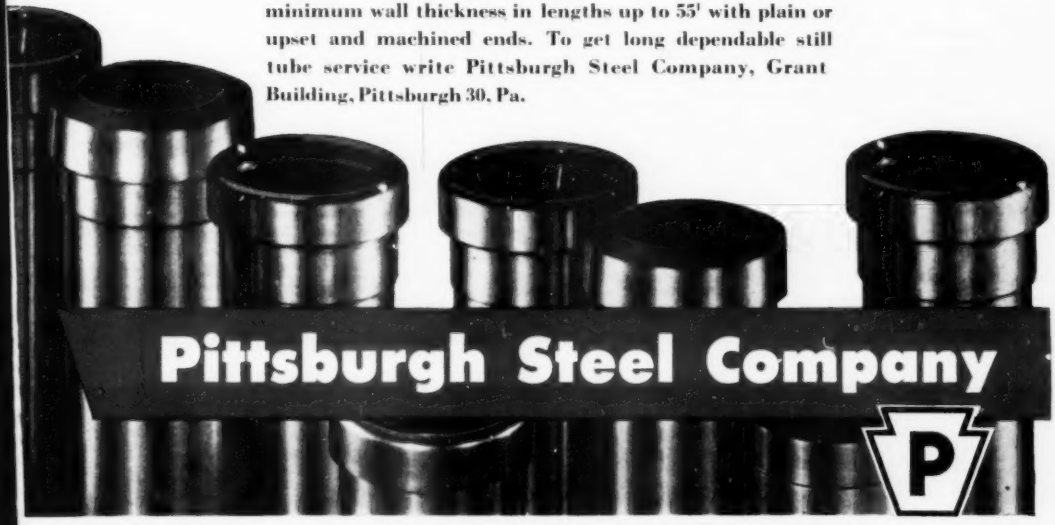
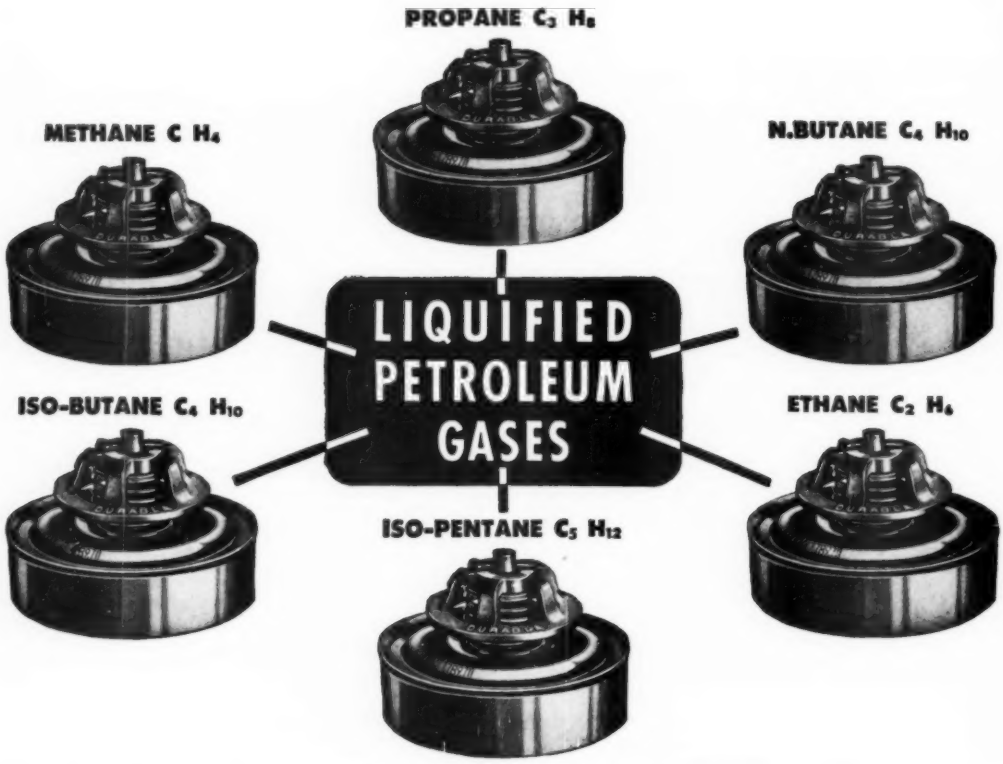
Pittsburgh Still Tubes

You get long dependable service when you install Pittsburgh Still Tubes in your refinery equipment. They are produced especially to resist the severe heat, pressure and corrosive action of your operations—with economy. Numerous grades of alloy steels ranging from low molybdenum and intermediate chrome-molybdenum alloys to the higher grades—including stainless have been developed to meet your problems of creep strength corrosion and oxidation.

In order to take full advantage of the wide range of analyses, sizes and wall thickness available, our metallurgical engineers will be glad to work with you in specifying the proper tubes for your next installation. Pittsburgh Still Tubes are made in sizes from 2" to 6" outside diameter (in some cases even larger) from .134" to 1" average or minimum wall thickness in lengths up to 55' with plain or upset and machined ends. To get long dependable still tube service write Pittsburgh Steel Company, Grant Building, Pittsburgh 30, Pa.





DURABLA PUMP VALVES FOR LIGHT HYDROCARBONS

When close clearance or any other design of reciprocating pumps are used for handling the greatly increased production of light hydrocarbons, DURABLA METAL PUMP VALVE UNITS* are your guarantee of high performance, freedom from "gassing" and replacement problems. The arched and curved shape of the valve member absolutely minimizes "slip", cavitation, and turbulence. DURABLA Valves are precision engineered, especially for this service.

Pump valves all open with a tilt action towards the flow line or line of least resistance. DURABLA Valves, being free-tilting, follow this natural law, which is not possible with high hub stem-guided valves or wing guided valves where large side friction is caused when they attempt to tilt in accordance with this basic law . . . and no other free tilting valve is as light as the DURABLA Valve.

ONLY DURABLA OFFER ALL THESE ESSENTIAL FEATURES FOR LIGHT HYDROCARBON SERVICE

- Feather Weight Valve Member
- Free-Tilting Valve Member Without Side Friction
- Snap Action Under Any Load
- Positive Seal Independent of Contraction and Expansion of Gases
- Does Not Need Lubrication
- Compact Design, Stocked in 11 Standard Sizes to Fit Any Pump

Write DURABLA Engineering Department for information and Bulletin, Reference 9G7

*Patent Numbers 2090486, 2117504

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"SCOREKEEPER FOR MODERN OIL FIELDS"

BOWSER PORTACHEK

- ACCURATELY RECORDS GROSS PRODUCTION
- FURNISHES TRUE PROPORTIONAL SAMPLE
- PROVIDES PERMANENT, INDISPUTABLE RECORDS
- DETECTS SLEEPERS OR WET WELLS

and by **ELIMINATING GAGE TANKS,** *Portachek—*

- REDUCES PUMPING AND TRANSPORTATION COSTS
- STOPS EVAPORATION LOSSES
- MINIMIZES FIRE HAZARDS

ENGINEERED TO HANDLE ANY TYPE OF OIL WELL PRODUCTION WITH THESE *PROVED* WELL-CHECK UNITS

1. Bowser Special Oil Well Xacto Meter.
2. Bowser True Proportional Sampler.
3. Bowser Spillproof Gas Trap with patented Peel-Off Valve—no packing glands—no valves to grind or adjust.

Dependable operation is assured on flowing wells, pump pressure or vacuum—either as mobile units or for permanent installations. Bowser meter engineers are always at your service for counsel or recommendations on Well-Check Systems for all types of wells. Write Bowser, Inc., 1328 Creighton Avenue, Fort Wayne 2, Indiana, or direct to the nearest district office.

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BOWSER OIL WELL METER WITH AUTOMATIC SAMPLER

. . . provides reliable records of oil well production—*both quantity and quality*—AT THE WELL!

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This simple valve eliminates conventional back pressure regulator, oil valve and float flange. *There's nothing to get out of order!*

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Winner in every field

When the green flag is down and the going's tough — that's when American Bosch *super-powered* magnetos really shine. For years, American Bosch has been building magnetos that have what it takes to make a winner — on the race track . . . in the air . . . and under the roughest farm and industrial use. It's that wealth of experience that gives American Bosch magnetos their rugged dependability, ace-high performance, and ability to deliver long years of trouble-free service. Next time you need a magneto, make it an American Bosch . . . you couldn't buy a finer magneto.

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Again in '49, American Bosch magnetos proved their metal in the gruelling Memorial Day Classic. Of the first ten; — 2nd, 5th, 6th, 7th and 10th places went to cars equipped with American Bosch's latest type MJL Magneto, while the 1st, 3rd and 4th places went to cars equipped with pre-War Bosch models. The same know-how and production skill that builds these star performers of the race track are yours when you buy an American Bosch magneto for your farm or industrial engines.

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How RUGGED is RUGGED

...and is it important in an instrument?

"How rugged" an instrument is, has a great deal to do with "how long" it will remain in operation. Regardless of how accurate, sensitive or flexible an instrument may be, the value is low if the instrument goes out of service.

Our interpretation of an instrument's "ruggedness" is the ability to operate, under the most adverse conditions encountered, on applications for which it is intended.

In addition to being built to operate under outdoor conditions, the construction of the Republic Pneumatic Transmitter is more like that of a precision machine than of the sensitive instrument that it is. The design both permits and requires strength, as the force-balance principle could not be carried out with light, bendable parts. All bearings, levers, pins and other working parts must be heavy enough to carry appreciable loads and are therefore not susceptible to damage in ordinary handling or use.

We repeat—"ruggedness" is an important feature of the Republic Pneumatic Transmitter.

★ ★ ★

The Republic Transmitter is a pneumatic metering device. It employs the force-balance principle to convert process variables such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures become direct measurements and can be conducted to reading instruments or used as the measuring impulse for the actuation of an automatic controller.

For complete details write for Data Book No. 1001

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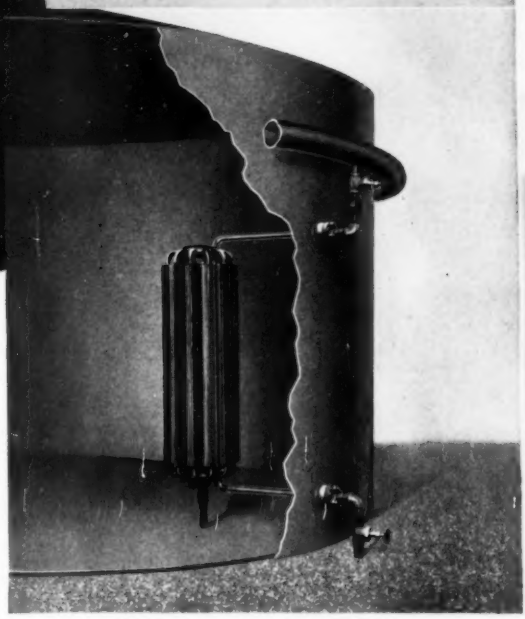
BROWN FINTUBE *Thermo-Flo* TANK HEATERS



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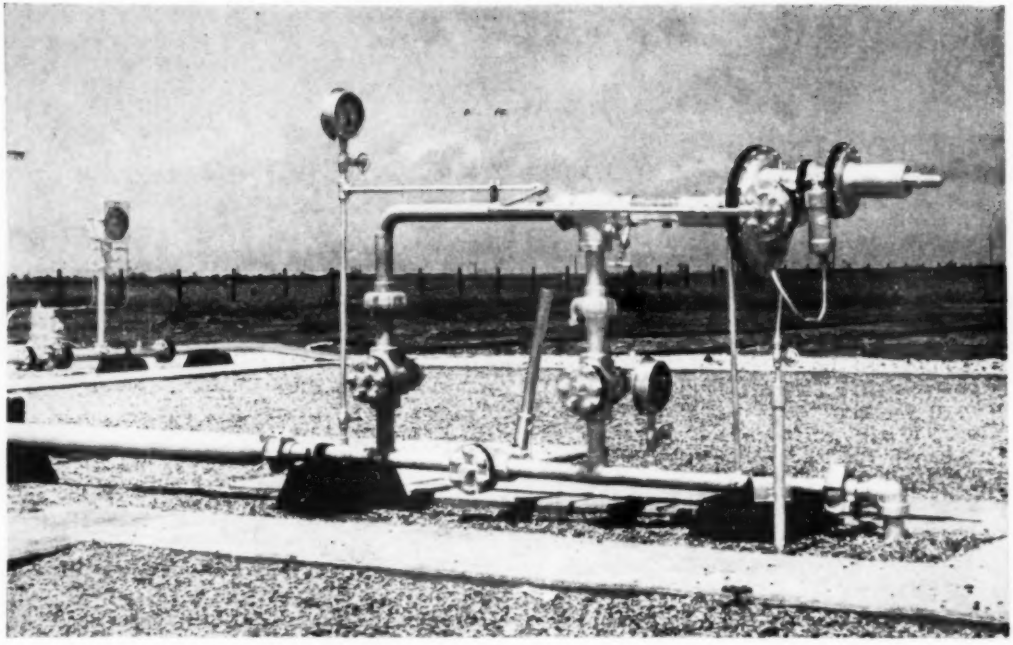

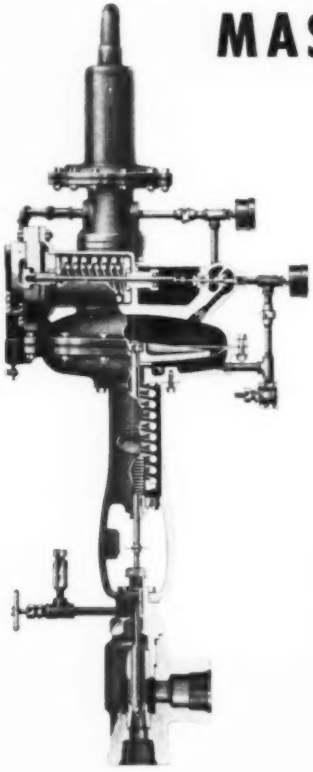

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Reducing Natural Gas from 2000 lb. to 450 lb.

The above picture shows a typical Gulf Coast gas well installation for reduction of high pressure natural gas. This system utilizes the MASON-NEILAN Type 27-718 Pilot-Operated Pressure Reducing Regulator, normally closed, for reducing high pressures to reduced pressures suitable for field operations. This particular installation is serving as pressure make-up to compressors for natural gas injection, and is handling pressures from 2000# inlet to 450# reduced pressure. It is furnished complete with a 2" "MECO" prefabricated manifold, shop-tested and assembled, making it suitable for connection to new or existing field systems.

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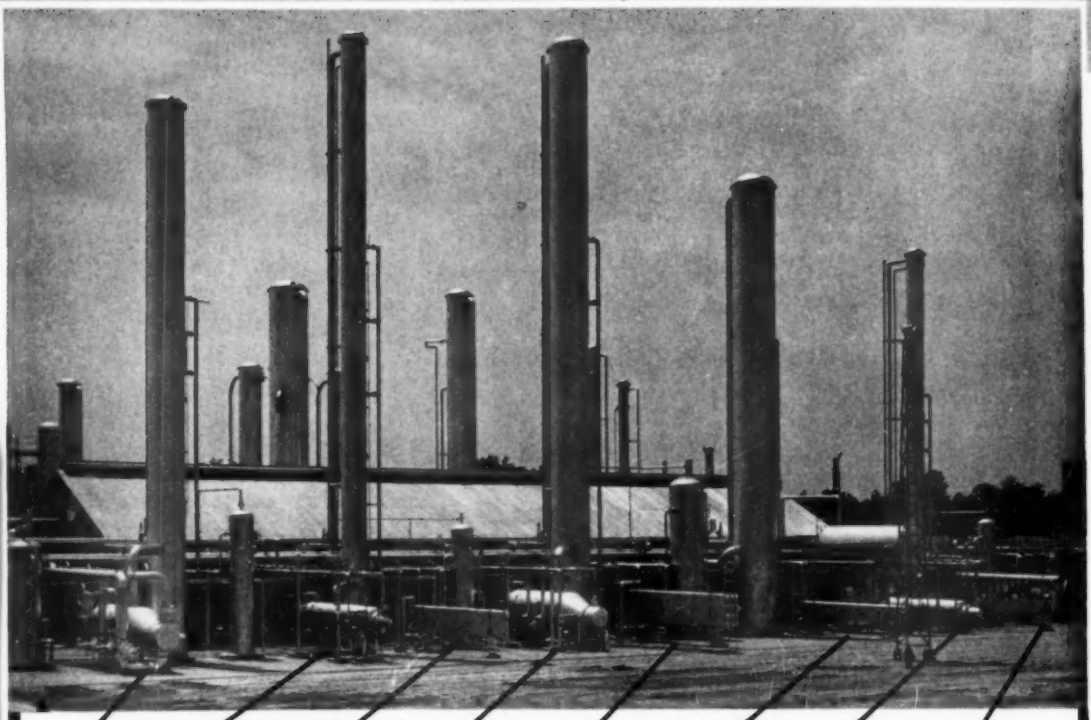
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TWIN G-FIN SECTION FRACTIONATOR FEED EXCHANGER
DE-ETHANIZER REBOILER
TWIN G-FIN SECTION BOTTOMS EXCHANGER

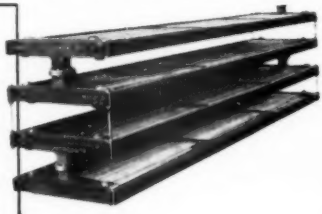
This portion of a large modern south-western natural gas absorption plant contains the G-R apparatus listed above. The plant also contains 60 G-R Bentube Sections and a large number of G-R Tubular Heat Transfer Apparatus not shown in the illustration.

G-R REBOILERS

For producing vapor from liquids heated with steam or hot liquids. The illustrated kettle type has a large vapor space above the tube bundle.

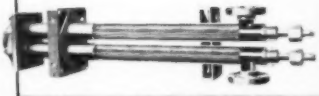
G-R BENTUBE SECTIONS

Patented design of atmospheric or submerged cooling and condensing sections consisting of parallel rows of tubing set with slight initial bow into cast header at each end. Change in temperature causes corresponding change in curvature of the tubes which cracks up and breaks off scale.



G-R TWIN G-FIN SECTION

Standard, interchangeable units of patented hairpin design, consisting of a single G-Fin element, with longitudinal fins within a shell. More than 40,000 of these units are used on practically every heating, cooling or condensing service.



G-R TUBULAR EXCHANGERS

Include many patented features based on 80 years of experience in building heat transfer apparatus. Available in a wide range of types for condensing, heating, cooling or exchanging heat between liquids, gases and vapors.

GRISCOM-RUSSELL: PIONEERS IN HEAT TRANSFER APPARATUS

A good example of G-R "RANGE-ABILITY" at this plant

"RANGE-ABILITY"... the ability to serve efficiently through a wide range of service requirements . . . is a characteristic of G-R Heat Transfer Apparatus.

For example, in G-R Twin G-Fin Sections, this "RANGE-ABILITY" is obtained by simply connecting, in series or parallel, as many of these standard, interchangeable units as required by the duty. The accompanying photograph is a good illustration. This modern natural gas absorption plant uses four banks of G-R Twin G-Fin Sections as follows:

De-propanizer Exchanger — 3 sections connected in series

De-butanizer Bottoms Exchanger — 3 banks in parallel, each bank containing 4 sections in series

Fractionator Feed Exchanger — 2 sections connected in series

De-ethanizer Bottoms Exchanger — 4 sections connected in series

The same plant uses 60 G-R Bentube Sections (not shown in the illustration) for cooling tower service. These sections are another example of G-R "RANGE-ABILITY" obtained through standard designs, and are operating at pressures ranging from 125 psi to 2750 psi in this plant.

In other types of G-R apparatus, "RANGE-ABILITY" is obtained by designs which cover all duties. For example, the accompanying photographs also show various types of steam-heated and oil-heated reboilers; and the same plant is using many other designs of G-R Tubular apparatus as still feed preheaters, vapor condensers, oil-to-oil exchangers, gas heaters, gas coolers and aftercoolers.

No matter what may be your heat transfer requirements, be sure to consult Griscom-Russell for authoritative ratings and exactly suitable designs of proven performance.

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GR-209

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Why do these pins add life to the chain? Because the pins are treated by a special process to provide maximum hardness on the pin-wearing surfaces while retaining softness in the pin ends to assure proper riveting.

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Another important feature provided by the copper plated pins is ease of disassembly. The soft ends permit the pin to be easily driven out of the pin links with proper hammer blows.

Add to these important advantages, the other life-adding, cost-cutting features of Baldwin-Rex Roller Chains and it's easy to see why they're an Oil Field favorite.

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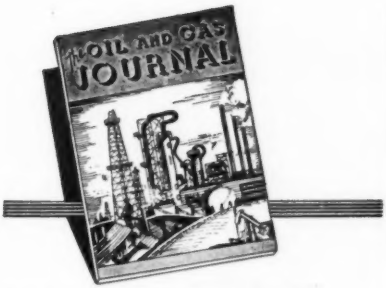

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JOURNALLY Speaking

Colored Statistics

THE bigdomes of the Journal's brains department can work up a healthy disagreement on almost any subject, but the most complete and violent diversity of opinion always comes on the choice of a color to dress up a special section.

Our staff artist, poor fellow, has tried just about everything the spectrum has to offer, only to run into a chorus of "I don't know anything about art but any color would be better than that one." So now he makes his own choice without confiding in anyone else.

The bluish tinge used as background for the Midyear Report section appearing somewhat to the east of this page was picked, he assures us, to furnish a cool, soothing effect for summer reading and not by any means to suggest that there is anything blue about the outlook for the petroleum industry.

As a matter of fact, the statistics themselves have a decidedly rosy hue. The way our statisticians see things, the oil industry is turning its postwar corner this month, and from now on every direction is up. And the figures aren't colored; only the background.

So take advantage of whatever frigidity our artist has contrived to impart, make a cool analysis of the cold facts, and decide for yourself whether there is anything to be blue about.

All That Glitters

WHILE Californians this year are celebrating the hundredth anniversary of the gold rush that followed the discovery at Sutter's mill, the Pennsylvania Grade Crude Oil Association is preparing to celebrate the ninetieth anniversary of the oil rush that followed the discovery at Drake's well.

There's a lot of parallelism in the two histories, though the gold story has been worked over more by the glamour writers.

The '49-ers and their followers have become a symbol of pioneering, optimism, and individual resourcefulness.

The '59-ers and the other oil pioneers were of the same breed.

Oil and gold, both sought for private gain, opened new regions to settlement, enriched the nation, and formed the basis for lasting and diversified economy.

Historians may argue whether gold or oil contributed more to the world, but we'll bet on oil. The '49-ers belong to history. The oil pioneers are still going strong.

Continental's Club

THIS department recently noted the formation of a Defensive Drivers' Club among the employes of Continental Oil Co. and is now pleased to report that more than 90 per cent of the drivers of Continental's company cars and trucks have taken the pledge to beware of the other guy's carelessness and thereby earned the right to wear distinctive lapel buttons.

So have more than 50 per cent of the car owners on Continental's far-flung rolls, and the company's highway safety record has taken a big turn for the better. What's more, Continental's idea has aroused interest of other oil companies, and the club may soon be called on to establish chapters elsewhere.

That's fine. Now if all other drivers are going to look out for us, maybe we will dare to venture out on the highways the next time our wife and children can do without the family car for a few hours.

Light on Butane

MANUFACTURERS of light hydrocarbons, seeking new market outlets for their current overproduction, may be interested in an advertisement by a Dallas department store for a pocket cigaret lighter which operates on butane. But an economic study of the possibilities is a bit discouraging from the standpoint of mass consumption, for the ad states that the lighter costs $30, and one 75-cent refill will provide 3,000 lights.

—Henry D. Ralph

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2 For the 17th straight year International Trucks lead in heavy-duty sales. The country's most exacting truck buyers are the men who buy trucks of 16,001 pounds GVW and over. Their vote of confidence in International is based on truck value —the same truck value found in every International . . . light, medium, and heavy-duty.

3 More than half of all International Trucks ever built—in 42 years—are still at work. International has been building rugged trucks uncompromised by passenger car design or construction since 1907. International Trucks are built to last—and they do.

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the OIL AND GAS JOURNAL

FOUNDED IN 1910 BY PATRICK C. BOYLE

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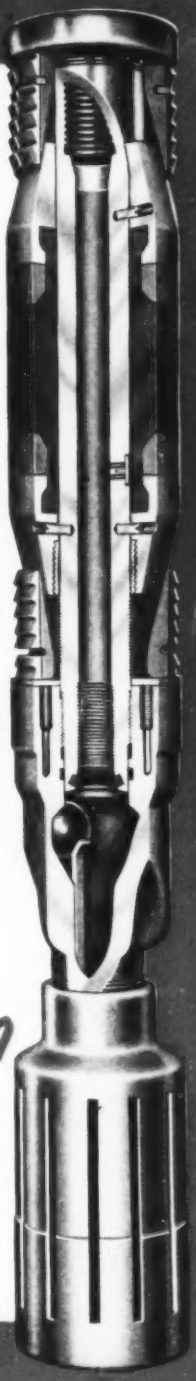
why are more and more Baker Cement Retainers being made of magnesium ?



That's a fair question and here's the answer:

Magnesium is chosen for making many products because of its light weight as compared to steel, cast iron, or any suitable non-ferrous metals. This is not true of the Baker ***Magnesium*** Alloy Cement Retainer, (Product No. 5-400) where ***magnesium*** is used on account of the greater *ease, speed and safety* with which it can be *completely drilled up.*

All major parts of this retainer are made of ***magnesium*** except the annularly segmented nitricastiron slips, which readily break into small pieces when drilling out.

The special ***magnesium*** alloy employed has *ample strength* for all types of *remedial or secondary* cementing, and is well suited for use as a *temporary* bridge plug to prevent movement of liquid or gas up or down the hole. For a *permanent* bridge plug, use the Baker **Cast Iron** Cement Retainer, as certain well fluids ultimately produce a chemical reaction on the ***magnesium.***

Both the ***Magnesium*** Alloy Type and the Cast Iron Type are run on tubing or drill pipe either as a retainer for cementing or testing, or as a casing bridge plug.

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A successful method recently has been developed for setting the Baker Model "K" Retainer Bridge Plug when run on a wire line. The savings in running time, savings of wear and tear on drill pipe or tubing, and other worthwhile advantages, merit your consideration of the "Baker Wire Line Bridge Plug" as it is popularly referred to in the field. Any Baker representative or office will furnish the names of service organizations ready to assist you.

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. . . on the Baker ***Magnesium*** Alloy Cement Retainer, and its many efficient applications, refer to your BAKER (or Composite) CATALOG, or address:

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THE OIL AND GAS JOURNAL

A Refinery Arm

THE week's developments include the announcement that the industry's oldest and largest product pipe line—the Great Lakes system—will approximately double its capacity. In transportation the expansion is final proof that a common-carrier jointly owned by and serving a number of refineries can today successfully cope with problems not otherwise solvable.

In this connection, product movement has become more than a pipe-line shipment. As perfected by several companies it is, in effect, a combination transmission-distribution activity involving the handling of several products under a deposit-and-withdrawal arrangement comparable to a banking service in general business. It now includes large storage, laboratory control, and other services required by buyer and seller in a combination operation of this magnitude.

The net result is that within less than two decades the success of product pipe lines has brought about major changes in the oil industry's operations not fully appreciated by many in close touch with activities.

What has happened in Oklahoma and Kansas refining is a case in point. Twenty-five years ago the two states had 66 operating plants with crude runs to stills of 220,000 bbl. daily, or 12 per cent of the domestic total.

Shortly thereafter it became apparent to close students of the industry that the refining industry of the two important oil-producing states was on the decline. The advantage of being adjacent to oil fields was more than offset by the large rail costs in disposing of products to distant points in competition with refineries located there and served by crude-oil lines.

In 1930 five companies decided to make a final effort to save their refinery investments in Oklahoma and Kansas. It took courage to embark on this pioneering undertaking. A major business depression was under way. Dire predictions were made by skeptics as to the difficulties that would be met in moving gasoline by pipe line.

There were many operating bugs to overcome but this radical departure was successful from the start. It saved the refining industry of the two states. Otherwise it would have been contracted so that only local needs would have been supplied. The Great Lakes system and smaller lines have given an increasing number of refinery operators the assurance they needed to expand their plant facilities to maintain their share of the large markets to the North and East. Oklahoma-Kansas crude runs to stills now average about 425,000 bbl. daily and will be increased.

The mounting rail rates since the close of the war and the many improvements in product transportation, including the shipping of several products in one system, have further strengthened the position of this newest transportation method. It is now certain that its application as a major arm of the refining industry has still a long way to go.

With Output Down, Demand Up

Residual Prices Move Higher

by Henry D. Ralph

THE action of Esso Standard Oil Co. in increasing the price of residual fuel oil on the Gulf Coast by 15 cents per barrel last week is easily explained by examination of the statistics, which show that demand has increased and promises to be better, while output has been lowered and stocks are falling rapidly.

There is good reason to believe that this price rise will stick and might be increased later. Before too long it should be reflected in a firming of resid prices in other areas except, perhaps, California. It does appear to be a definite upward turn in the price of heavy fuel oil. However, it will not by itself mean a stiffening in the prices of other petroleum products, because their supply-demand conditions are not identical.

The recent history of resid prices is an excellent example of the delicate relationship between price, demand, and supply, and of how a product can be priced out of the market. Resid is more responsive to these forces than other petroleum products because of the competition with coal, as the two fuels are interchangeable in many plants.

No Change in New York

In January 1948 No. 6 fuel oil was quoted on the Gulf Coast at $2.56 to $3.50 per barrel, and in New York Harbor of $3.03 to $3.90. The price had been run up to that peak by virtue of coal shortages, the momentum of the postwar reconversion demand, and the spirit of inflation. This stimulated the already high production of heavy fuel oil at a time when the demand for oil, as such, was leveling off and when coal could be obtained and was a better value. The Gulf Coast top price of resid dropped to $3.25 per barrel in March 1948, later to $3.00, then $2.65, then $2.52, where it remained until the end of the year, at which time the New York Harbor price was $2.90. There were sharp reductions early in 1949, and on May 21, Esso posted $1.20 on the Gulf Coast. Esso's new Gulf Coast price, effective July 18, is $1.35. So far there have been no comparable price increases in New York Harbor nor in other areas.

What may have surprised many oil men about the 15-cent increase was that there was no forewarning in the national figures on resid stocks, which have held about 20,000,000 bbl. above last year for several months (page 374 of this issue). Actually, however, more than half of the stocks are in California, while stocks on the Gulf Coast and East Coast together are at their lowest point in a year.

The important areas in the resid market are the East Coast, where most of it is consumed, and the Texas and Louisiana areas, which ship heavily to the East Coast. California has its own market and, as the figures here show, is in a much worse position than the rest of the country. The other refining areas ship little heavy fuel oil out of their districts.

Stocks Still Dropping

As shown in Table 1, stocks began to rise early in 1948 and reached a high point last December, coinciding with the top price. They have continued to rise in California, which kept up the national stock figure but have been declining steadily on the Gulf-East Coast. The rate of change shown in this table is striking. During the second quarter of 1948 Gulf-East Coast stocks increased 16,330 bbl. daily, while during the second quarter of this year they decreased 8,040 bbl. daily. Stocks are still declining, at a season when they normally build up, which explains why Esso stated it has not been able to obtain sufficient heavy fuel oil to meet demands.

Since stocks represent the difference between supply and demand, the declining Gulf-East Coast stocks indicate that there is a shortage in these areas. The reason for this is that the price has been so low that refiners made as little as possible, whereas last year when the price was high they made as much as possible.

This is shown in Table 2, which gives crude run to stills, and Table 3, which gives refinery yields of residual fuel oil.

Note that in the three districts which supply the bulk of the heavy fuel oil to the big consuming market, both runs to stills and yield of resid dropped considerably more than the national average, while in California the trend was the other way. Thus while the stock situation continued to look bad on a national basis, production was less than demand in the areas where the market is flexible and sensitive.

For the entire United States, actual refinery production of residual fuel oil plus crude used as fuel without refining was about 10,000,000 bbl. less during the first 4 months of 1949 than during the same part of 1948, a decrease of about 6.4 per cent. This was greater than the decline in demand.

An article beginning on page 195 of this issue analyzes the demand, and shows that during the first quarter of 1949 demand for resid was 2.8 per cent below the same period of 1948, 6.8 per cent below the second quarter, and 4.7 per cent below for the entire first half year. It is estimated that demand will be 0.5 per cent over last year during the third quarter, and 7.8 per cent greater the fourth quarter, with an average increase of 4.4 per cent for the last half. This would make total demand for resid during 1949 only 0.4 per cent below 1948, while the estimate for the six winter months is 5.8 per cent over last winter.

Many refiners frankly admit that they priced themselves out of the heavy-fuel market a year or more ago. At present prices, however, heavy fuel oil gives considerably more heat per dollar than bituminous coal on the Eastern Seaboard and prospects look good for a continued firm market in that area.

TABLE 1—RESIDUAL FUEL STOCKS
(Thousands of barrels)

	Gulf-East Coast	California*	United States*
1948—			
Jan. 1	16,632	12,324	38,149
March 31	14,284	13,380	34,192
June 30	17,240	17,555	44,213
Sept. 30	25,240	21,037	58,682
Dec. 31	27,525	24,647	64,021
1949—			
March 31	21,227	27,386	58,190
April 30	20,096	29,622	59,688
June 18	20,534	33,986	65,594
July 9	20,104	35,837	67,136
July 16	20,151	36,269	67,564

*California and U. S. data for 1948 are comparable with 1949 except for small amount of secondary stocks.

TABLE 2—RUNS TO STILLS
(Thousands of barrels daily)

	Gulf-East Coast	California	United States
June 1949	2,363	958	5,236
June 1948	2,732	878	5,632
Change	—369	+80	—396
Per cent change	—13.5	+9.1	—7.0
April 1949	2,401	894	5,141
April 1948	2,705	864	5,539
Change	—304	+30	—398
Per cent change	—11.2	+3.5	—7.2

TABLE 3—REFINERY YIELDS OF RESIDUAL
(Expressed as per cent)

	East Coast	Texas Gulf Coast	Louisiana Gulf Coast	California	U.S.
1948—					
January	26.4	19.4	17.2	38.4	23.6
February	28.5	19.2	18.0	37.0	23.6
March	27.5	20.5	18.2	39.7	24.3
April	26.5	21.0	18.0	38.3	23.9
May	28.0	19.4	16.7	38.0	23.4
June	24.4	19.2	17.3	40.4	22.8
1949—					
January	26.4	18.3	15.1	42.2	23.7
February	26.3	18.5	14.7	40.9	23.5
March	26.2	19.1	14.0	41.6	23.7
April	24.2	17.9	12.6	40.9	22.2
May*	23.3	19.2	10.4	41.6	22.2
June*	22.8	18.9	11.0	38.9	21.5

*Estimated from A.P.I. weekly reports.

$55,000,000 Project to Double Great Lakes System's Capacity

by Paul Reed

GREAT LAKES PIPE LINE CO., which operates the largest product pipe-line system, will spend $55,000,000 in approximately doubling its facilities to transport gasoline and other products from Oklahoma and Kansas refineries to several consuming centers in the Middle West.

The program was announced by Harry Moreland, president, following the successful negotiation of loans to finance the mammoth project. Work will start in the near future.

The private sale of $55,000,000 of $3\frac{1}{8}$ per cent 20-year sinking fund debentures was consummated with eight institutional investors. Decision to expand was the result of a study by the Great Lakes organization revealing present lack of pipe-line capacity, making it necessary for connected refiner shippers to transport a considerable volume of products by railway tank car into the Great Lakes distribution territory.

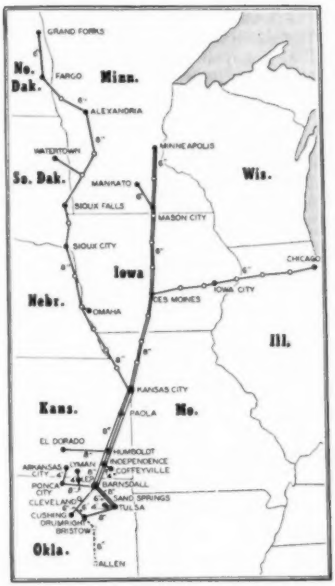
No Date Set

The company has not yet determined when construction will begin or in which part of the system increased capacity will first be available. The physical structure of the system and its location permit progressive stages of construction and allowance for variations that may be indicated by a continual study.

The Great Lakes company, headquarters of which are in Kansas City, was organized in 1930 as a joint undertaking of several companies operating refineries in Oklahoma and Kansas, and it became the first large system for the transportation of products. The original line has been gradually expanded in capacity and in number of refineries and terminals served, with major additions completed in 1947.

Present deliveries of gasoline and other products total about 100,000 bbl. daily, to be increased to 176,200 bbl. daily with the completion of the present program. This will entail the laying of 1,298 miles of 12-in. and 150 miles of 8-in., both along existing routes, together with attendant pump stations and increases in tankage and loading-rack facilities at present terminals.

Along the 12-in. lines, pump stations will be at 100-mile intervals; on other lines they will be at 50-mile intervals. Increase in line capacity would make it possible for the company to discontinue the present uneconomical operation of temporary pump stations at 25-mile intervals.



Map of the area served by the Great Lakes system, showing lines serving cities along the routes

Pipe laying will take the form of looping, rather than extension of existing lines. While no statement has been issued by the company as to the location of the loops, it may be observed that the distances from Tulsa along existing Great Lakes lines via Kansas City to Grand Forks, N. D., and Minneapolis total approximately 1,298 miles, which happens to be the length of the 12-in. construction just announced by Great Lakes.

The 1945-47 postwar modernization and expansion program for increasing Great Lakes capacity 50 per cent had not been completed before it became apparent that additional capacity was needed. Through facilities added by that undertaking the system reached a total of 3,129 miles.

Common Carrier

Great Lakes operates as a common carrier transporting products for 16 refineries at 12 locations in Oklahoma and Kansas and two Oklahoma natural-gasoline plants to distribution locations in Kansas, Nebraska, South Dakota, North Dakota, Iowa, Minnesota, and Illinois, as shown on accompanying map. Currently Great Lakes is reported to handle four grades of products: one premium, two house-brand, and one distillate.

The southern focal point of the Great Lakes system is the Barnsdall, Okla., terminal junction point where each of two 8-in. lines, one from Ponca City, Okla., and the other from Tulsa, connects directly to one of the two 8-in. "matching" lines to Kansas City. Incoming shipments from the Cushing-Barnsdall 6-in. line and the Tulsa-Barnsdall 6-in. line go into Barnsdall terminal tankage, from which they are sent through the third 8-in. line from Barnsdall to Kansas City.

North of the Kansas City terminal, which is the heart of the system, products move through the northwest 8-in. line to Alexandria, Minn., and through two 8-in. lines to Des Moines. From tankage at these points products are forwarded through the Alexandria-Grand Forks 6-in. and the double 6-in. to Minneapolis.

Stock in Great Lakes Pipe Line Co. is owned by eight oil companies, according to reports: Continental Oil Co., Mid-Continent Petroleum Co., Sinclair Refining Co., The Texas Co., Pure Oil Co., Phillips Petroleum Co., Cities Service Oil Co., and Skelly Oil Co.

Imports, War Reserve to Highlight NPC Meeting

WASHINGTON.—Oil imports and oil for war will be the principal subject of discussion to come before the National Petroleum Council at its July meeting here this week.

The most pressing matter is that of imports, on which independent domestic producers have been demanding controls for some weeks.

There will also be considerable discussion of the problems involved in developing a substantial domestic reserve productive capacity against a possible emergency.

Gamble Named Head of Tanker-Study Group

WASHINGTON.—The National Security Resources Board has initiated a study of our merchant marine with a view to planning for the adequacy and effectiveness of American shipping in the event of war.

The study is one of a number which the board is making into the various phases of transportation. Five committees have been set up under a special Sea Transport Survey group of which Major Philip B. Fleming, chairman of the Maritime Commission, will be the head.

M. G. Gamble, general manager of the marine department of Standard Oil Co. (N. J.), has been named as chairman of a working group which will survey the tanker situation.

In Imports vs. Exports Debate It's How You Use the Figures

by John C. Casper

THE current controversy over the volume of oil imports and exports is due in large part to a difference in terms and in the bases used in compiling statistics.

One set of figures can be used to make it appear that the United States is a net exporter. For example, not long ago Eugene Holman, president of Standard Oil Co. (N. J.), said: "In 1949 imports of crude oil and petroleum products into the United States averaged 513,000 bbl. daily. Total oil movement out of the country during the same period were in excess of 635,000 bbl. daily."

On the other hand, spokesmen for independent producers cite government figures showing that 1948 imports were 514,000 bbl. daily while exports were only 369,000 bbl. daily. The same basis for May 1949 shows imports of 579,000 bbl. daily and exports of 359,000 bbl. daily.

The fact is that both statements are correct. The two groups are talking about different things. Government figures on exports do not include all shipments of oil away from this country. The difference lies in classification of shipments to noncontiguous territories, bunkering of vessels in foreign trade, and purchases here for use by United States armed forces abroad.

Different Bases Used

Statistics are issued both by the Department of Commerce and the Bureau of Mines, and they differ in their treatment of our territories. Commerce data are compiled on the basis of political United States and include transactions by the territories. Therefore Commerce import figures include foreign products received by the territories, and exports include any reshipments of United States products from the territories. The Bureau of Mines reports on a continental basis and includes only shipments into or out of continental United States.

There is also a slight month-to-month difference in the crude-import figures of the two agencies, because they use different sources of information. Commerce figures are based on port records, while Mines gets reports from refining companies.

Bunker fuel loaded in American ports by ships in foreign trade is not classed as an export by either agency and is generally thought of as part of domestic demand. It is, technically, oil leaving our shores, and in 1948 it averaged 167,000 bbl. daily, as shown in Table 1.

Petroleum products bought in the United States but shipped to United States armed forces abroad are also treated as part of domestic demand and are not included in official export statistics. During the war such shipments were a military secret, and they still have not been published.

However, at the specific request of The Oil and Gas Journal, the Munitions Board furnished information for the past 18 months, which appears in Table 2. This shows that military shipments from continental United States to overseas destinations averaged 92,193 bbl. daily in 1948, and 69,840 bbl. daily the first half of 1949. These data are not available on a monthly basis. The table also discloses, for the first time, military purchases outside of this country and used by our forces abroad, which figures, incidentally, do not show up as imports by any country.

TABLE 1
Bunker Fuel, Laden on Vessels in Foreign Trade at Continental United States Ports
(Barrels daily)

1948	American vessels	Foreign vessels	Total
January	103,987	59,383	163,370
February	120,013	70,532	190,545
March	112,931	71,666	184,597
April	112,258	67,949	180,207
May	105,539	64,173	169,712
June	112,276	71,585	183,861
1949			
January	84,328	70,337	154,665
February	85,786	72,875	158,661
March	91,246	76,593	167,839
April	96,437	77,208	173,645
May	83,574	74,401	157,975

TABLE 2
Military Shipments from Continental United States to Overseas Destinations
(Barrels daily)

	Full year 1948	First 6 months 1949
Fuel oil	14,213	10,624
Diesel oil	18,538	12,608
Motor gasoline	29,735	22,475
Aviation gasoline	23,325	16,763
Kerosine	1,710	221
Jet fuel	2,937	
Lubricating oils	1,735	
Other		*7,149
Total	92,193	69,840

*Mostly jet fuel and lubricating oils, data not yet broken down.

Military Shipments From Sources Outside Continental United States to Overseas Destinations

Fuel oil*	35,356	61,691
Diesel fuel	19,489	21,939
Motor gasoline	7,295	7,635
Aviation gasoline		
Kerosine	240	
Jet fuel		
Lubricating oils	49	
Other	38	
Total	62,467	91,265

*Mainly for occupation forces in Japan for military and civilian use.

This explanation shows how it is possible to say with complete truth that total oil movements out of the United States are greater than exports, and also greater than imports. It is simply a matter of definition.

To recapitulate, here are the data for 1948: Total imports into continental United States were 514,000 bbl. daily and total exports were 369,000 bbl. daily. But total gross shipments out of the country can be figured at 628,000 bbl. daily by adding in 167,000 bbl. daily of bunker fuel laden on ships in foreign trade and 92,000 bbl. daily of military shipments from this country.

The chart on page 175 shows imports and exports on the basis used by the U. S. Bureau of Mines.

Independents Agree on Action to Curb Imports

WASHINGTON. — Members of the executive committee, state vice presidents, and the import-policy committee of the Independent Petroleum Association of America held a 2-day session in Washington last week at which the outstanding subject of discussion was the import situation.

The meeting agreed to support the Thomas amendment to the Reciprocal Trade Act, providing for a quota on imports of oil, or, if that amendment is rejected by the Senate, the Millikin amendment retaining the "peril point" provisions written into the act by the eightieth Congress.

Oil men attending the I.P.A.A. mid-year session declared that at least 25 per cent of the country's drilling rigs already are stacked as a result of the steady increase in imports and said that in some areas the proportion of idle rigs has reached 50 per cent or higher.

Refiner spokesmen said that every barrel of residual fuel imported into the country offsets 5 bbl. of domestic crude, since, in refining, residual accounts for 21 per cent of the products and once refiners' tanks are filled with residual that cannot be moved there is nothing they can do except curtail operations.

I.P.A.A. members are conferring with oil-state delegations. Russell B. Brown, general counsel of the association, expressed confidence there would be sufficient votes to adopt the Thomas amendment.

Members of the Texas delegation, meanwhile, discussed the situation with State Department and Tariff Commission officials, and the former agreed to call in representatives of the importing companies to see whether any arrangement could be worked out for a voluntary curtailment of imports.

this week

GOVERNMENT—United States and Mexico suspend negotiations over a proposed $203,000,000 loan to finance Mexican oil development. . . . President Truman expresses hope talks will be resumed in near future. . . . ¶National Security Resources Board begins sending questionnaires to 800 petroleum, chemical, rubber industry representatives to get industry opinion on synthetic-rubber needs and national rubber policy. . . .

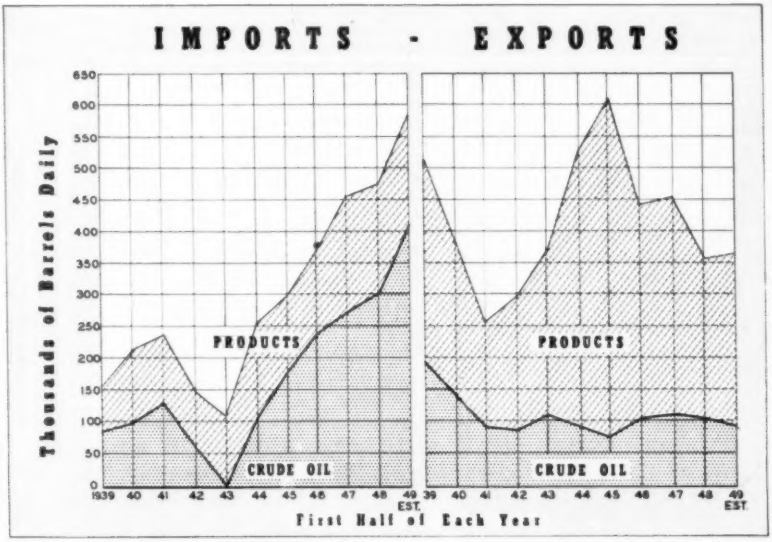
TIDELANDS—Texas School Land Board unanimously rejects proposed legislation for compromising tidelands issue. . . . Bill prepared by House Speaker Sam Rayburn given tentative approval by Louisiana and California. . . . Texas body lists five main objections, submits list of amendments containing special provisions for Texas. . . .

INTERNATIONAL—Alberta Premier E. C. Manning rules out immediate export of gas from province, declaring present supply is insufficient to supply Alberta needs and provide margin for export. . . . Manning says government will approve no applications for export permits in near future. . . . Statement clarifies government policy following enactment of new law providing strict control over gas production and transportation. . . . ¶Commercial production of natural gas in Alaska is confirmed by military. . . . Small fraction of output to be piped to Point Barrow to meet local demand. . . . Three exploratory wells now being drilled. . . . ¶Anglo-Iranian Oil Co., Ltd., and Iranian Government reach agreement on royalties under which company will increase payments about 50 per cent. . . . New rate to be retroactive to January 1, 1948. . . . ¶New refinery placed on stream in Australia. . . . ¶Construction expected to begin soon on new Sun Oil Co. refinery near Sarnia, Ont. . . .

TRENDS—Kerosine production for week ended July 16 averaged 218,700 bbl. daily, the lowest since the drop in refining activity just after the end of the war. . . . Refinery runs at that time were 4,300,000 bbl. daily compared with 5,130,000 bbl. daily last week. . . . ¶Kerosine stocks east of California are only about 4,100,000 bbl. above last year. . . . Stocks were about 6,100,000 bbl. above last year at the end of May. . . . If low runs and yields continue, kerosine stocks may be lower than last year by the end of this quarter. . . . ¶Gasoline and kerosine stock decreases for week of July 16 were greater than distillate and residual increases for a net drop of 132,000 bbl. in major products stocks. . . .

REFINING—Union Oil Co. of California announces plans to construct new $5,000,000 research plant near Brea, Calif. . . . Will supplant old research facilities at Wilmington. . . . ¶Formal opening of Carter Oil Co.'s new 20,000-bbl. refinery at Billings, Mont., will be held August 26. . . .

PIPE LINES—Great Lakes Pipe Line Co. announces $55,000,000 project to approximately double capacity of huge products system. . . . Company plans to lay 1,298 miles of 12-in. and 150 miles of 8-in. pipe. . . . New lines to parallel existing facilities. . . . No date set for beginning construction work. . . . ¶Canadian syndicate known as Northern Pipeline, Ltd., formed to construct proposed $10,000,000 Montreal-Ottawa-Toronto 400-mile, 10-in. products pipe line. . . .



Petroleum imports have climbed far above exports in recent months, according to figures of the U. S. Bureau of Mines on which this chart is based. But these figures do not give the complete picture of movements into and out of the United States, as explained in the story on the opposite page. This chart should be viewed against the background of conditions in the oil industry at present and the outlook for the rest of 1949, as given in the Journal's special Midyear Report beginning on page 185 of this issue

Mexico, United States Suspend Drawn-Out Loan Negotiations

by Bertram F. Linz

WASHINGTON.—Refusal of Washington officials to finance oil exploration and development by Petroleos Mexicanos led last week to the breaking off of negotiations for an oil loan to Mexico.

The suspension of talks was instigated by the Mexican government, and State Department officials expressed the hope that they might be resumed at some future time, stressing, however, that any financial aid granted must be in line with the established policy of the United States.

The breakdown of the discussions was announced by the State Department, which said they had not "resulted in an understanding between the two governments on a basis under which the desired financial aid would be extended." Department officials declined to go beyond this officially, in line with a Mexican request that no details be given officially as to why the negotiations were suspended.

Crude Output Questioned

It was learned, however, that State Department officials believed that the Mexican government itself could not immediately develop the additional crude production required to justify the construction of refining and other facilities for which a loan was desired.

It was indicated at the department that President Truman had been kept apprised of the course of the discussions and had approved the decision to break off negotiations. Over the past several months, the President had said repeatedly that he was in favor of giving Mexico financial assistance for its oil industry but had made it clear the matter was in the hands of the officials directly concerned and had indicated that their decision would be controlling.

At a news conference July 21, however, the President denied he had been consulted about the breaking off of negotiations, and expressed the belief they would be resumed in the near future. The President said he had not been consulted about the loan at any time, and that the first he knew about the latest development was when he read it in the newspapers.

The discussions between the two governments were at all times on an informal basis and no official application for a loan ever was filed with the Export-Import Bank, through which the money would have to be advanced.

At the outset of the negotiations, Sen. Antonio Bermudez, Pemex head, was informed that the Export-Import Bank could not advance money for exploration and development, because that was a field in which private capital could and would participate, and the negotiations thereafter were restricted to a loan for refining and other facilities. State Department officials have never admitted that the conversations got to the point where definite figures were discussed, but it has been reported generally that Mexico wanted $203,000,000 for these facilities and might be given something in the neighborhood of $100,000,000.

Many Factors Involved

A number of factors were involved in the consideration of Mexico's request, of which the general principle of protecting the opportunities for private capital was only one. Another factor was the desire of the military establishment to develop sources of oil supply close to home, and still another was the traditionally close relationship between this country and Mexico and the desire of the Administration to help Mexico attain a position of financial stability.

But a factor weighing heavily on the other side was the present world situation of over-supply and contracting markets for American oil companies and the fact that an oil developed by Mexico in excess of internal requirements could find a market only in the dollar-oil area.

The making of any loan to Mexico for oil development was strongly opposed by important members of the oil industry, both on the ground that no aid should be given to governments who operate oil monopolies and bar private capital and also on the premise that no encouragement should be given to new foreign oil competition with domestic producers.

Open Doors Asked

When it came down to a discussion of terms on which a loan could be made, United States officials strongly pressed Mexico to open its doors to private capital and that government was told that the construction of additional processing and distribution facilities would be justified only by increased production, which it was felt could be secured most healthfully by private company exploration and development.

Since the increase in processing facilities was not justified by the production now in sight, it was finally agreed there was no point in continuing the negotiations further.

It is understood that as a result of the termination of the discussions, the Mexican government now is studying the possibility of making more contracts similar to that held by the Pauley-Davies-Mosher group.

Start Buying, Hallanan Warns Fuel Suppliers

THERE is danger of spot shortages of fuel and heating oils next winter if purchases by suppliers are deferred much longer, Walter S. Hallanan, chairman of the National Petroleum Council, declared last week.

"So far as production is concerned, the industry is prepared to meet every demand of the American people," he said, "but if those demands are permitted to pile up and fall upon the industry all at once, a very serious transportation problem will be presented. . . . Beyond a certain point there is no flexibility."

Speaking before the West Virginia Oil and Gas Association, Hallanan said there are sound reasons for believing that production cut-backs will be restored late this year and early in 1950.

"We have come to realize," he said, "that in the matter of practically all petroleum products except gasoline we have been face to face with a buyers' strike for the last several months.

"This has not been a strike by consumers so much as by marketers and distributors whose secondary storage, ordinarily well filled at this time of year, is virtually empty."

Directors Vote Merger Of Pan American, Root

A new company, Pan-Am Southern Corp., has been formed by the merger of Pan American Petroleum Corp. and its subsidiary, Root Petroleum Co. Directors of both firms approved the move July 25.

Bruce K. Brown, now president of Pan American, will leave his position as vice president and director of Standard Oil Co. (Ind.) to become president of the new firm.

Pan-Am Southern will have its headquarters in New Orleans, with exploration, producing, purchasing, and pipe-line activities to be directed from Shreveport, where principal offices of Root have been located.

The new company will operate two refineries, the 25,000-bbl. Root refinery at El Dorado, Ark., and the 9,500-bbl. Pan American refinery at Destrehan, La.

Pan American is primarily a marketing firm and Root a refining company.

Bill to Compromise Tidelands Question Rejected by Texas

A PROPOSED compromise on the tidelands-ownership question remained just a proposal this week after the Texas School Land Board unanimously rejected the bill drawn up by House Speaker Sam Rayburn.

Earlier Louisiana and California were reported "near agreement" on the bill, which would give the federal Government control of the areas in question and provide for a federal-state split of revenues.

The School Land Board voted not to oppose the measure "insofar as it affects other states which are satisfied with its terms." However, the board cited five main objections to the bill as it now is written and indicated it will insist upon several amendments if the legislation is to receive its approval.

Contents of the proposed compromise were disclosed last week by Louisiana's attorney general, Bolivar Kemp, who said it would:

1. Give the federal Government control and management of all oil and gas leases from inland waters seaward.

2. Divide the proceeds from oil, gas, and mineral leases, 62½ per cent to the coastal states on leases within the 3-mile limit and 50-50 outside this limit to the end of the Continental Shelf.

3. Permit states to retain all tidelands revenues received up to January 1, 1949.

4. Require amendment of federal leasing laws to require competitive bidding for leases.

5. Give the states undisputed control and ownership of all inland waters and reserve to the states control over fish, oysters, and shrimp.

Special Provisions Asked

Lieut. Gov. William J. Dodd, who also attended the Washington conference, said Louisiana is ready to accept the compromise as the best that could be expected, although not entirely satisfactory. Dodd said Rayburn had assured him that approval of the bill by the states involved would guarantee its passage during this session of Congress, before the Supreme Court acted on the Government's suit against Louisiana and Texas.

The Texas School Land Board, composed of Gov. Allan Shivers, Land Commissioner Bascom Giles, and Attorney General Price Daniel, listed its five major objections to the bill.

1. It does not vest ownership or title to any part of the property or minerals in the state.

2. It treats Texas as the other coastal states, limiting its boundary, in spite of treaty recognition of Texas' 3-league ownership.

3. The right of the state to pursue court action to secure its claim to ownership of the lands and minerals beyond the 3-mile limit is not clearly stated.

4. The right of the state to sand, gravel, fish, shrimp, oysters, and other marine life is not confirmed or vested by the bill.

5. The bill does not provide for acceptance or approval by the Texas legislature of the terms which require action by state officials.

Louisiana Approves

The board urged that the bill, if introduced, be amended to include the following special provisions for Texas.

1. Fully recognize Texas' ownership within the original 3-league boundary.

2. Make an exchange of revenues on a 50-50 basis for income from both state and federal areas.

3. Give the state full management within state boundaries.

4. Give the state police powers, including conservation, taxation, and exploration over the entire area to the outer margin of the Continental Shelf.

5. Allow state lessees to continue to pay rents and royalties under state leases until a competent court should rule otherwise.

6. Grant Texas a quitclaim to the land beneath all inland waters.

7. Provide that neither Texas nor its lessees should be liable to the federal Government in any way for operations prior to the effective date of the act.

8. Confirm all rights granted by the state to build docks, wharves, and other structures and grant the state such rights in the future.

The board instructed Giles to return to Washington for further conferences with Rayburn.

McIntyre Resigns From International Trade Post

WASHINGTON.—Francis E. McIntyre, assistant director of the Office of International Trade, has resigned, effective August 1, to join California Texas Oil Co. as director of economic research with offices in New York.

McIntyre, a former teacher of economics at Stanford University and later at the University of Indiana, entered government service at the outbreak of the war. He served first in the Lend-Lease Administration, later as special adviser to the then assistant secretary of state, Will Clayton, and joined the Department of Commerce as director of export control in 1946, one of his responsibilities in that post being the determinations with respect to export licenses for pipe for the trans-Arabian pipe line.

Commercial Gas Output In Alaska Is Confirmed

WASHINGTON.—Formal announcement of the discovery of natural gas in commercial quantities in Naval Petroleum Reserve No. 4 was made this week by the National Military Establishment.

The discovery has been known to the oil industry for some months, but the official announcement was withheld until pressures and production performance proved the existence of a deposit of gas which Commodore William G. Greenman, director of Naval Petroleum Reserves, said is "considerable."

The gas was found some 6 miles south of Point Barrow, Alaska, where the South Barrow No. 2 well now is flowing in sufficient quantities to meet the fuel requirements of the Naval installations at Point Barrow, to which it will be piped.

"This discovery, plus the shows of oil and gas tested in wells drilled in other parts of the reserve, justify the careful exploration program being conducted by the Navy in Alaska," Greenman declared.

Exploration of the reserve began in the fall of 1944, the work being carried on first by Navy Seabees and since the end of the war by contractors. Five deep wells have been completed and three are now being drilled, and with the exception of one of the three now under way all have revealed shows which encourage the belief that commercial oil fields exist in the region, Greenman added. This phase of the program will be completed with the drilling of additional test wells.

The first test well, South Barrow No. 1, was abandoned as a dry hole although it found enough oil and gas shows to warrant the drilling of South Barrow No. 2. The indications found by the tests in various parts of the reserve show that oil and gas are far more widespread in the area than originally anticipated. The whole difficulty has been the absence of reservoir rocks in the locations drilled.

South Barrow No. 2 hit gas and was completed at 2,505 ft. It has a possible flow of 4,000,000 to 5,000,000 cu. ft. daily but is being produced at 10 per cent of that capacity, which represents the local demand for gas, and the reservoir is estimated at something better than 3,000,000,000 cu. ft.

International

WORLD-WIDE OIL DEVELOPMENTS

Alberta Government Says "No" To Immediate Export of Gas

IT may be some time before pipe lines are built to carry natural gas from the Canadian province of Alberta west through Canada and down the United States West Coast.

This was indicated last week in the statement of Alberta Premier E. C. Manning that no application for an export permit will be considered at present.

Manning said the government is not yet convinced there is sufficient natural gas to supply the needs of Alberta and provide a margin for export. And, he added, "the government's first and foremost responsibility is to protect the interests and welfare of the people of this province and we are determined to carry out this responsibility to the best of our ability."

The Alberta premier's statement was issued to clarify the government's policy following a recent special meeting of the province legislature in which strict controls over the proposed export of natural gas were written into law. *(The Oil and Gas Journal, July 21, page 46).*

Several Projects Affected

The statement of policy affects directly several companies which in the past year have announced plans for construction of huge natural-gas lines to move the fuel westward across Canada.

Latest of these proposals was announced in May by Pacific Petroleums, Ltd., of Canada and associated interests. These interests proposed a 30-in., 1,400-mile line running from the Alberta gas fields through British Columbia to Vancouver and then south through Washington and Oregon and into northern California. *(The Oil and Gas Journal, May 19, page 166).*

The new law, the Gas Resources Preservation Act, was piloted through a 4-day session in the house by Manning, who held, against strong minority opposition, that the province could not constitutionally prohibit the export of gas.

As finally passed, the bill provides for issuance of permits to gas-export companies, but gives the Petroleum and Natural Gas Conservation Board wide powers to designate sources of the gas, fix allowables, determine maximum rates of withdrawal, and to require ratable withdrawals.

It also assures Albertans along the route of any line to be built of a gas supply at a "reasonable price."

Shell Rejects Offer for Its Hungarian Property

THE Royal Dutch-Shell Group has rejected an offer of the Hungarian Government for the properties of its Hungarian subsidiary.

In London, officials of Anglo-Saxon Petroleum Co. told the Hungarian Minister that the offer was tantamount to expropriation. Anglo-Saxon is one of the major holding companies of the Royal Dutch-Shell Group.

The Hungarian Government offered to pay £484,000 ($1,936,000) over 10 years for the subsidiary, Shell Koola. The Anglo-Saxon company's statement said that assets were valued by the company at more than £2,300,000. The properties include a refinery at Csepel.

The company statement said that the offer made it "abundantly clear that the Hungarian Government intended to obtain possession of our interests for a nominal sum bearing no relationship to their actual values." The company also said it reserved all rights under treaties and international law against the Hungarian Government, including claims for damages.

Shell's Hungarian properties suffered the same fate as have virtually all other foreign oil assets in Communist-dominated European countries since the war. Standard Oil Co. (N.J.) Hungarian properties were seized after government charges of economic sabotage.

Aerial Survey of African Concession Is Completed

The aerial mapping and magnetometer survey of Mozambique Gulf Oil Corp.'s 47,000-square mile concession in Portuguese East Africa has now been completed.

Compilation of aerial magnetic maps will continue over the next several months. On the basis of these studies, ground exploration will be undertaken where indicated. Mosaic maps also are being assembled for use in stereoscopic studies and development planning. The aerial survey in Mozambique was begun last July by Aero Service Corp., and during the Mozambique rainy season the company did other mapping-magnetometer work in the Union of South Africa for mining interests.

Italian Lube-Oil Plant To Rebuild With ECA Aid

WASHINGTON.— Rehabilitation of the lubricating-oil manufacturing facilities and installation of a reforming unit at the Aquila S.p.a. Tecnico Industriale refinery near Trieste has been approved by the Economic Cooperation Administration, which will contribute $4,250,000 toward the $7,950,000 project.

The Aquila refinery, Italian owned, began operations in 1937 with production of the full range of petroleum products, including lubricating oil. It was bombed and nearly destroyed during the war, and while it was reconstructed in 1946-47 the lubricant-production facilities were not rebuilt and the plant produced only gasoline and other light products. Its present crude capacity is 12,000 bbl. per day.

Under the project, modern facilities for the manufacture of lubricating oils will be installed, and a reforming unit will be constructed to improve the octane value of the gasoline base stocks. It is planned to produce around 610 bbl. daily of lubricants upon completion of the new facilities.

Caltex Participating in Project To Complete Spanish Refinery

International

THE organization of a new Spanish refining company, in which California Texas Oil Co., Ltd., is participating, has been completed.

The new company will take over, complete, and expand a plant now under construction at Escombreras Valle, near Cartagena, a major Spanish seaport on the country's southeast coast.

Government-controlled Spanish interests commenced this plant of 5,000 bbl. daily capacity prior to the war. Housing, tankage, power plant, and other facilities are virtually complete and construction of the process units is under way.

This plant may go in operation by the end of the year. The program of the new company, known as R.E.P.E., calls for expansion later to a throughput of 20,000 bbl. daily.

First in Spain

The refinery will be the first in Spain itself. Cepsa (Cia. Espanola de Petroleos, S.A.) is now expanding its refinery in the Spanish Canary Islands to 17,000 bbl. daily. Cepsa is one of the partners in the new Cartagena project. The original refinery at Cartagena was undertaken by Calvo Sotello.

Caltex (Standard Oil Co. of California and The Texas Co.) holds a 24 per cent interest in the new Spanish company and, according to reports from Madrid, will make a loan of $9,000,000 to the new enterprise. Capital of the new company will total about 325,000,000 pesetas $(29,835,000).

Caltex directors in the new company are D. J. Hanna, vice president of Caltex; William M. Brewster, the company's representative in France; and J. A. Alvarez, representative in Spain. There are 10 Spanish directors. Caltex's present marketing operations include Spain.

To Receive Dollars

The joint Spanish-American refinery company is the first major project involving capital of the two countries since the war. Caltex is understood to have received guarantees from the Spanish Government that it will be able to take its dividends out of the country in dollars.

A Caltex announcement said designs are now under way to complete the refinery and expand its capacity. The completed refinery of Escombreras Petroleum Refinery, S.A. (R.E.P.E.) will have the modern equipment for crude distillation, thermal reforming, polymerization, and other facilities for the production of high-grade petroleum products, including gasoline, kerosine, fuel oil, lubricants, paraffin wax, and asphalt, Caltex said.

The Caltex 24 per cent interest is held through Caltex Oil Products Co. The National Institute of Industry holds 52 per cent, while the remaining 24 per cent is held by Cia. Espanola.

Anglo-Iranian Co. Raises Iran Crude-Oil Royalties

A pact has been signed by Iran and the Anglo-Iranian Oil Co., Ltd., giving the Iranian Government larger oil royalties, according to the company.

While the pact awaits ratification by the Iranian Parliament, under its terms the British-owned firm must pay Iran 6 shillings ($1.20) per ton instead of 4 shillings (80 cents) for oil it pumps out of its 100,000 sq. mile concession in Southwest Iran. The pact is a supplement to an agreement signed in 1933 between Anglo-Iranian and the government which gave the firm exploration and exploitation rights.

The new 6-shilling royalty rate will be retroactive to January 1, 1948, the company announced. The firm produced nearly 25,000,000 tons of oil in the country in 1948.

According to reports, the company's total payments to Iran for 1948 will be approximately £17,000,000 ($68,000,000) compared with a little over £7,000,000 ($28,000,000) in 1947.

Start Expected Soon on Sun Refinery Near Sarnia

SARNIA, Ont.—Start of construction on a $20,000,000 refinery by Sun Oil Co. on a St. Clair River site south of Sarnia is expected in the near future.

Demolition of an old factory on the site now is under way.

Some years ago interests connected with Sun purchased the 125-acre Dominion Alloy site and leased an additional 50 acres of the Sarnia Indian reserve for 80 years.

Difficulty in obtaining steel and crude oil supplies have delayed the project until now.

New Australian Refinery Is Placed on Stream

Vacuum Oil Co., Ltd., Australian subsidiary of Standard-Vacuum Oil Co., has placed on stream its new 1,200-bbl. refinery in Melbourne.

The refinery, operating on heavy crude oil from Venezuela's Tia Juana field, will produce in quantity diesel oil, asphalt, and lubricating oils now imported into the country. Its gasoline production will be small.

Later the company expects to operate on crude oil from western New Guinea. While exploratory work is in progress, Australia now has no commercial oil production.

German Discovery Has 290-Bbl. Initial Output

AN initial production of 46 cu. m. daily (about 290 bbl.) on pump is reported for the new German discovery, Ruehlertwist 2, near the Dutch Border in the Emsland region of Western Germany.

The well was deepened after preliminary production tests had indicated a production of 50 to 94 bbl. daily. The operator is Wintershall, A.G., a German company. Further development of the area is planned. *(The Oil and Gas Journal, June 9, page 141).*

Successful stepouts in other German fields have been reported. Deutsche Erdoel opened up a new producing section with its Meldorf 81 between Hemmingstedt and Meldorf near Heide field. The well had an initial production of 20 to 25 cu. m. (125 to 155 bbl.) of light oil daily from 1,324 m. (4,350 ft.).

On the edge of Weingarten field near Bruchsal, C. Deilmann Bergbau found oil in Werrabronn 3. Initial production of about 5 tons daily (35 bbl.) later dropped to 2½ tons. Georgsdorf field in Emsland was extended west about 700 m. as a result of Georgsdorf 100 which was reported to have had a daily output of 22 to 25 cu. m. (140 to 155 bbl.) from 972 m. (3,200 ft.).

Prospects that German operators will obtain substantial quantities of American oil equipment appeared remote in view of reports that American authorities had stipulated that none of the $1,000,000 allocation set up under the European Recovery Program for this purpose would be used for drilling, production, and refining equipment. The action, it was said, makes the allocation virtually useless.

On another side of the German oil industry, the Alfred Wirth & Co. oil-equipment plant in Erkelenz is now reported restored and prepared to resume its prewar production program, including rotary rigs, derricks, winches, and pumps. The export business has been restored to some extent, though restricted to certain items, including spare parts.

Industry Being Asked to Help Mold Synthetic-Rubber Policy

WASHINGTON. — Studies to help develop legislation for the disposal of government-owned synthetic rubber plants and establish a permanent national policy on synthetic rubber were inaugurated last week by the National Security Resources Board.

An interagency advisory committee to handle the matter was set up by Presidential Assistant John R. Steelman, acting chairman of the board, who pointed out that the subject is of pressing importance since the Rubber Act of 1948 requires that the President submit recommendations to Congress before next January.

A questionnaire has been prepared which shortly will be sent to some 800 representatives of the rubber, petroleum, and chemical industries who will be asked to submit their views on a variety of problems concerned with the future of the synthetic-rubber industry, including the need for continued Government regulation.

The questionnaire is designed to develop the opinion of the three industries on the following points:

The minimum quantity of GRS, if any, that must be produced and consumed annually to provide continuing technological advancement in its production and utilization.

The minimum quantity GRS, assuming total active and standby capacity of 600,000 long tons (including facilities for feed stocks), that must be produced and consumed annually in order to insure rapid expandability of production and utilization in the event of a national emergency.

The estimated annual consumption of GRS on a completely voluntary basis, assuming present levels of total consumption of new rubber, if the price of average grades of natural rubber over a reasonable period of time were approximately the same as GRS, 2 cents above GRS or 2, 4, or 6 cents below GRS.

Whether facilities for the production of GRS (including butadiene facilities) should be owned or operated by the Government or private industry.

The estimated annual consumption of butyl rubber on a completely voluntary basis, assuming present levels of total consumption of new rubber, if the price of average grades of natural rubber over a reasonable period of time was approximately the same as butyl, 2 cents above butyl, or 2, 4, or 6 cents below butyl.

Whether facilities for the production of butyl should be owned and operated by the Government or private industry.

Assuming that Government regulations are necessary to support production and minimum consumption of synthetic rubber, which of the following 5 methods should be applied:

1. Active specification controls, the method now used.
2. Standby specification controls to be imposed only if and when the overall rate of synthetic rubber consumption falls below a stated minimum.
3. Mandatory purchase, with manufacturers of rubber products required to buy synthetic in amounts equal to a stipulated proportion of their purchases of natural rubber.
4. Some form of government subsidy.
5. A tariff on natural rubber.

Whether the disposal plan outlined by the Reconstruction Finance Corp. April 1, last *(The Oil and Gas Journal, April 7, page 54)* would provide a satisfactory method of disposal of plants to private industry, and result in an adequate supply of synthetic rubber to consumers.

Gas-Act Exemptions for Independents Approved

WASHINGTON.—The House Interstate Commerce Committee last week ordered a favorable report on legislation exempting independent producers and gatherers of natural gas from control by the Federal Power Commission.

The bill was sent along to the House after some 4 weeks of argument in the committee as to how far it should go, and in essence it parallels the measure ordered reported late last month by the Senate interstate commerce committee.

The measures which now are ready for House and Senate vote represent the maximum which supporters of last session's Rizley-Moore bill believe can be salvaged, and provide that arm's-length sales of gas by independent producers or gatherers at or prior to the point of delivery into interstate pipe lines shall be exempt from FPC control.

Court Dissolves Four Flare-Gas Injunctions

Temporary injunctions prohibiting operators from flaring gas in four Texas fields were dismissed last week in an Austin District Court.

Suits against operators in La Gloria, Slaughter, Fullerton, and North Withers were dissolved after it was shown that plants had been constructed to serve all fields and that all wells except those given exceptions by the Texas Railroad Commission had been connected to lines.

Suits to Test New Mexico Severance-Tax Law Filed

Two suits designed to test New Mexico's 1949 severance-tax law have been filed in District Court in Santa Fe by Louis Lujan, attorney for the state bureau of revenue.

One action asks the court to determine whether a $200,000 annual exemption for taxpayers and creation of a state permanent fund from tax income are parts of the law, since neither is mentioned in the law's title. Another seeks clarification of terms used in the severance-tax act.

Next Week

Modern drilling and production practices in South Iran.—This paper was presented this month at the Fourth Empire Mining and Metallurgical Congress in London by H. W. Lane, O.B.E., of Anglo-Iranian Oil Co., Ltd. It will be published in three Journal issues, covering in detail, with several illustrations, one of the most interesting and important field operations of the petroleum industry. The first article will describe drilling methods and mud techniques. The second will have to do with pressure-drilling practices and associated operations. The third installment is concerned with the many unique production practices in the Iranian field. You will want to read and save the entire series.

Colorado's first catalytic cracker.—In this article the authors, the operating company's process engineer and two engineering-company men, describe in detail the performance of Continental Oil Co.'s new catalytic unit at Denver.

Care and maintenance of drilling engines.—An outline of a course recently made available to oil-field personnel at Odessa College.

Chemicals from natural gas.—The Journal's engineering editor, Kenneth Barnes, shows and tells how a chemical company processes natural gas to produce a variety of chemicals.

Giant vacuum unit.—A pictorial article on Esso Standard Oil Co.'s huge new vacuum distillation unit by the Journal's refining editor, George Weber.

WASHINGTON WATCHING

BY BERTRAM F. LINZ

Hot Air or Hot Oil?

WASHINGTON.—Plenty riled over the heavy imports of foreign oil which have necessitated sharp cutbacks in allowable, the sovereign State of Texas is likely to take drastic action on its own account if neither Congress nor the Government takes steps to deal with the situation.

While Texas oil men haven't reached the stage where they are greasing the old muzzle-loader, they are honing some pretty powerful statutes and are ready to serve notice on those damyankee importers that they had better pack their foreign crude in their carpet bags and git while their oil is cool.

Reports from Texas indicate they are looking over their hot-oil laws to see if they can't be stretched to cover Saudi Arabia, and one oil man at least, believes they can.

Because of the fact that companies importing oil also own wells in Texas, Rudolph Kamon, Cisco geologist, recently wrote Sen. Tom Connally, the imported oil is subject to Texas state regulations "for being produced in violation of Texas proration rules to stop waste, those of the Interstate Oil Compact Commission, whose rules are violated by transporting illegally produced or hot oil in interstate markets or commerce, and their owners are liable in the United States and Texas for such violations.

"Furthermore," Kamon asserted, "these foreign-concession oil fields have not been reported to the nation's regulatory bodies by their owners, like they have reported their United States properties for regulation and production of oil to eliminate waste, and are gutting their unrestricted foreign oil fields by unrestricted and unregulated production of oil wells."

All this, the senator was warned, is very illegal and Congress better do something about it quick.

It's Still Alive!

ALTHOUGH negotiations have been suspended, the Mexican loan is far from dead.

There is considerable dissatisfaction in some quarters over the way the whole matter has been handled. Chairman Robert Crosser of the House Interstate Commerce Committee and Rep. Charles A. Wolverton of New Jersey who headed the committee group that went to Mexico last summer, are far from convinced that no way could be worked out to give Mexico assistance in developing her oil industry.

Crosser has asked the department to furnish copies of the notes exchanged between the two governments which preceded the announcement that the negotiations had been halted.

Both the President and the State Department have indicated a hope, if not an expectation, that the matter will be revived in the near future. It is believed, however, that overtures to that end must be made by the Washington Government since Mexican officials are not at all happy over the manner in which their request for financial aid was treated.

Administration officials are represented as quite concerned over Mexico's economic situation, strongly in need of bolstering, and loans for several activities have recently been under consideration. A loan has been arranged for railroad rehabilitation, but another for hydroelectric development has been turned down. It was a big question whether a loan to Pemex would tend to aid in the situation, but the conclusion appears to have been reached that it would not.

Found: The Man

SEARCH for a top-flight man to succeed Max W. Ball as director of the Oil and Gas Division appears finally to have been successful, and Interior Secretary J. A. Krug reportedly has fixed upon an appointee who may be announced to the National Petroleum Council at this week's meeting if the matter can be cleared in time.

The name of the man who is to be the next OGD head has not been revealed, but he is said to be one of four who have recently been under consideration, all of them declared to be of high caliber, conversant with the oil industry and its problems, and well qualified for what is intended to be the most important oil job in the Government.

Two of the four are in Washington —Col. Louis G. Cotulla, executive officer of the Armed Services Petroleum Purchasing Agency, and George McGhee, assistant secretary of state for Far and Middle East Affairs.

Cotulla has had extensive experience in the oil industry as a petroleum geologist and production engineer with Stanolind, Phillips, and Gulf, and in recent years has had experience on the other side of the table as representative of the industry's single customer. McGhee also has had extensive industry experience as a geologist formerly with DeGolyer & MacNaughton. He is a son-in-law of E. DeGolyer and has been with the State Department about 8 years.

The other two men prominently mentioned for the post are connected with state regulatory bodies—William J. Murray, Jr., chairman of the Texas Railroad Commission, and O. C. Bailey, chairman of the Arkansas Oil and Gas Commission.

Alec M. Crowell, Shreveport oil and gas consultant who also has been mentioned for the job, conferred last week with Assistant Secretary of the Interior C. Girard Davidson regarding the situation in the OGD, and said later that Secretary Krug has selected a prospective director, although it was indicated the man in question had not yet definitely accepted the appointment.

No Government Plants?

FORCED by changes in the economic picture to drop his demand for a $4,000,000,000 tax increase, President Truman may also abandon his idea of having the Government build plants for the production of synthetic liquid fuels, steel, and other commodities as an antidepression measure.

A provision authorizing the President to order such construction was originally included in an "economic expansion" bill written by a group of liberal Senators, but has been dropped from the measure actually introduced last week in both Senate and House.

The proponents of the legislation do not claim it has the endorsement of the President. But it is understood that some of his aides assisted in its drafting, and it is declared to be in line with Truman's recommendations in his midyear economic report.

President Truman has always been sold on the idea and embodied it in his program for combating inflation which was offered Congress last February as the Spence bill. When the apprehension of inflation turned into fears of deflation, the President modified his program slightly and offered it as a panacea for recession; originally proposed as a way of providing commodities in short supply, it was later offered as a means of making jobs.

There is no chance of legislation of any kind being enacted this year to deal with a recession, and the President's views on the newest formula are not expected to be made known until he delivers his annual message next January.

PERSONALS

Moore Named Production Superintendent of B.-A.

WESLEY W. MOORE, district superintendent of British-American Oil Producing Co. at Oklahoma City, has been appointed general production superintendent of the Mid-Continent division, with headquarters in Tulsa, W. E. Schoeneck, production vice president, announced.

This position had previously been unfilled, with Schoeneck handling work ordinarily handled by a superintendent in the Mid-Continent area.

Moore joined British-American in 1940 as a petroleum engineer in the Tulsa office. A year later he was named district superintendent at Oklahoma City. Prior to joining the company he served as engineer and superintendent for The Texas Co. from 1933 to 1935, and from 1935 to 1940 he served as a sales engineer for Oil Well Supply Co.

Moore received electrical and mechanical-engineering training at the University of Missouri and later took postgraduate work in geology at Denver University.

J. C. Bruce, formerly superintendent of the North Texas district, British-American Oil Producing Co., has been appointed superintendent of a new district consolidating the Kansas, Illinois, and Oklahoma districts, with headquarters at Oklahoma City. **Paul T. Hayward,** formerly superintendent of the Kansas district at Great Bend, has been appointed superintendent of the North Texas, West Texas, and New Mexico districts, with headquarters at Seymour, Tex.

James G. Lineham, recent Oklahoma graduate, has joined Imperial Oil, Ltd., as a petroleum engineer, headquartered at Calgary, Alta., Canada.

F. W. Archer has been appointed chief engineer of Monsanto (Australia) Pty. Ltd. He has been a chemical engineer for Monsanto Chemicals, Ltd., in London since 1946, and will leave for Melbourne as soon as his work on design of units at the company's new plant at Newport, England, has been completed.

H. D. McKinley has been appointed works manager of the new degreasing-solvent manufacturing plant being erected by Hooker-Detrex, Inc., at Ashtabula, Ohio. He collaborated on design, erection, and initial operation of the Tacoma, Wash., plant for the company, and transfers from a position as manager of solvents division, Detrex Corp.

William R. Goodier, exploitation engineer for Shell Oil Co., Inc., has joined Barnsdall Oil Co. at Newhall, Calif., as petroleum engineer, specializing in reservoir engineering.

Normand E. Slick, production engineer for Tide Water Associated Oil Co. at Ventura, Calif., has joined Oil Properties Consultants, Inc., Pasadena, Calif., as reservoir engineer.

John E. Conner has been named supervisor of experimental work at Bayway refinery labcratory, Esso Standard Oil Co., Linden, N. J. **W. Capehart Harney** was named supervisor of alcohol plant work in the chemical-products laboratory; **Dr. Henry O. Mottern,** formerly technician in the chemical products laboratory, was promoted to assistant head of the unit; and **Caleb E. Hodges,** former group head in the Paratone laboratory, was promoted to assistant head of that laboratory.

Fred S. Wright, district petroleum engineer, Magnolia Petroleum Co., who has been on a special assignment as chairman of the Salem Field Engineering Committee, Salem, Ill., has been promoted to assistant division petroleum engineer of Magnolia's Gulf Coast division, with headquarters at Houston. **Joseph M. McLaughlin** has been promoted from petroleum engineer in the Kermit producing district to assistant production foreman at Kermit, Tex.; **John S. Goodrich** has been promoted from assistant foreman to production foreman at Kermit; and **George C. Southerland, Jr.,** petroleum engineering assistant, has been transferred from the Lake Charles, La., producing district to the Kermit district.

Arthur H. Petsch, geologist for Ohio Oil Co. at Guatemala City, C.A., has been transferred to Amarillo, Tex., as district geologist.

Hartzel C. Slider, Paden City, W. Va., has joined the producing department of Shell Oil Co., Inc., in the Mid-Continent division, headquartered at Tulsa. He is a graduate in petroleum engineering from Ohio State University, Columbus.

H. H. Carrick, General Petroleum Corp., has been named assistant to the division production superintendent in the San Joaquin Valley area. **O. M. Hager, P. M. Barry, and William Alexander** were named engineers of the division.

John Arnold Weideman, formerly drilling engineer for Atlantic Refining Co., has joined Gulf Oil Corp. at Penwell, Tex., as a well tester.

W. E. Creech, Jr., production foreman at Eunice, La., for Atlantic Refining Co., has been transferred to Magnolia, Ark., as district foreman.

Jack Small, formerly with Central Pipe Line Co., has joined the geological staff of Calvert & Willis, Inc., at Olney, Ill.

Page O. Green, who recently received his B.S. degree in petroleum engineering at University of Texas, has joined General American Oil Co. of Texas at Odessa as production engineer.

Martin Sain, vice president of Sacor Oil Refinery, Lisbon, Portugal, recently observed the fiftieth anniversary of his entry in the oil industry. All of his career has been spent in Europe. Sain started his career in 1899 with Steaua Romana Oil Co. and was active in Romanian operations. In 1918 he founded the Redeventza group, which was granted a contract by which the Romanian Government supplied it with crude oil belonging to the government as royalty. Redeventza erected its own refinery in Ploesti and founded other companies in Romania, including Forajul,

and Xenia. In 1938, Sain, foreseeing the turmoil of war in Europe, abandoned all of the companies east of the Rhine and concentrated his activities in western Europe. In 1939 a new refinery was erected in Portugal, the Sacor, which now enjoys a prominent position in that company.

Dr. Nils K. Anderson has been named director of research and development for Deep Rock Oil Corp. at Cushing, Okla. For the past 3 years he has been associate professor of chemical engineering at Northwestern University. From 1941 to 1946 he was on staff of Universal Oil Products Co., working in engineering, research, and development. He received his B.S. degree in chemical engineering from Armour Institute of Technology, Chicago, and his Ph.D. from University of Wisconsin. **Dr. Delton R. Frey,** recently named manager of products application, and **Jesse B. Jackson, Jr.,** will assist Anderson on the research and development staff.

N. K. ANDERSON

Harry Hines, consultant in geophysical work, has opened a branch office in the Equitable Building in Denver to handle activities in the Rocky Mountain area. General offices are in Dallas.

Dr. Edmundon Luongo Cabello has been appointed head of the department of economy of the Technical Bureau of Hydrocarbons in Venezuela. He left Creole Petroleum Corp. to accept the appointment, and formerly served as director of hydrocarbons and head of the concession department in the same Venezuelan ministry.

R. J. Holley, assistant chief petroleum engineer in the Fort Worth offices of Gulf Oil Corp., has been promoted to assistant superintendent of production, succeeding **E. D. Brockett, Jr.,** who has been transferred to Pittsburgh. Holley will be in charge of the Panhandle and North Texas areas.

Martin J. Deuth, Shell Oil Co., Inc., has been transferred from Jackson, Miss., to Midland, Tex., as district geologist. He has been with Shell since 1938, when he joined the firm as a geologist in the San Antonio office. He is a graduate of DePauw University, Greencastle, Ind.

Stanley M. McDonald, geologist in New Orleans for Louisiana Land & Exploration Co., has been transferred to Midland, Tex., to be in charge of a newly opened office to serve the Permian Basin area.

C. E. Spencer, tank superintendent for Stanolind Pipe Line Co., Tulsa, since September 1946, has resigned to become general manager of Keyes Tank & Supply Co., Casper, Wyo. Spencer had been employed by the pipe-line firm since 1926.

J. T. Paddleford, independent geological engineer, has opened offices in Hobbs, N. M., to serve the Permian Basin area.

Joseph E. Keller, Washington counsel for the National Petroleum Association, has resigned to become associated with the Washington law firm of Dow, Lohnes & Albertson.

Charles J. Edelen, senior petroleum engineer, Stanolind Oil & Gas Co., has been transferred from Houston to Tulsa. Other changes include: **Harold M. Dunson,** senior petroleum engineer, transferred from Oklahoma City to Tulsa; and **Richard A. Morse,** petroleum engineer in the production department, Tulsa, promoted to research group supervisor at Stanolind's Tulsa research laboratory.

Harry Cain, district manager of United Gas Corp. at Longview, Tex., has been named assistant division manager at Beaumont. He will be replaced at Longview by **B. D. Bruyere. James D. Perdue** replaces Bruyere at Lufkin as local manager; **Glen W. Causey** replaces Perdue at Gladewater; and **J. R. Dreyer** replaces Causey as division chief clerk at Beaumont.

R. W. Gemmer, Tulsa, has been named chief geophysicist for Carter Oil Co., succeeding **Dr. A. B. Bryan,** now with the production-research department of Standard Oil Development Co. in New York City. Gemmer was on the geophysical staff of Humble Oil & Refining Co. in Houston for 9 years before joining Carter in 1935. During his service with Humble he was instrumental in development of the Blau-Gemmer method of electrical logging. He has been assistant chief geophysicist for Carter since 1947.

R. W. GEMMER

George B. Black, Sun Oil Co., has been appointed fire-protection engineer for the company, succeeding **Robert G. Guthrie,** who retired after 19 years' service. Black joined Sun in 1936 and served in the development department at the Marcus Hook refinery.

H. W. Dodge, former vice president of The Texas Co., and District 1 director for Petroleum Administration for War, has joined Mack Trucks,

Members of operation and maintenance group, division on combustion characteristics, of the Rocky Mountain section of the American Society for Testing Materials, who attended recent 2-day meeting which included a tour of the Wasatch Oil Co. refinery at Pocatello, Idaho, left to right: George E. Mann, Sinclair Refining Co., Sinclair, Wyo.; Myron Wolfe, U. S. Bureau of Mines, Laramie, Wyo.; Robert C. Stein, Carter Oil Co., Billings, Mont.; Larry Tollington, British American Oil Co., Ltd., Moose Jaw, Canada; Edward McCrorie, North Dakota State Laboratories, Bismarck, N. D.; F. L. Battle, Continental Oil Co., Denver; Don M. Loomer, Salt Lake Refining Co., Salt Lake City; Burl Knutson, North Dakota State Laboratories, Bismarck; Earl R. Ebersole, Wasatch Oil Co., Woods Cross, Utah; Harold C. Tammen, U. S. Bureau of Mines, Laramie, Wyo.; Harold Hammond, Wasatch Oil Co., Woods Cross, Utah; Chet Leggett, Socony-Vacuum Oil Co., Inc., Casper, Wyo.; A. T. Belk, Phillips Petroleum Co., Great Falls, Mont.; Turney G. Hitler and Kenney Johnston, Wasatch Oil Co., Pocatello; Glen C. Templeman, Ohio Oil Co., Lovell, Wyo.; and J. L. Adams, Salt Lake Refining Co., Salt Lake City

PERSONALS

Inc., as executive vice president. He recently has been Economic Cooperation Administration chief in Paris.

W. L. Stanton, petroleum engineer, has been named head of Texas Gas Transmission Corp.'s Shreveport, La., office, where he will be in charge of contracts, production, reserves, and geology. For the past 3 years Stanton has been director of Carthage Field Engineering Committee, Carthage, Tex. Following graduation from Texas A. & M. College, he joined Arkansas Fuel Co., and later Arkansas-Louisiana Gas Co.

Lyal H. Peyton has been promoted to senior engineering inspector at Esso Standard Oil Co.'s Baltimore refinery.

Dr. R. G. Hamilton has resigned from Schlumberger Well Surveying Corp. as manager of the Mid-Continent area, and has opened offices in Tulsa, where he will act as consulting geologist.

E. P. Hester, development engineer, Continental Oil Co., Ponca City, Okla., has been promoted to regional contract superintendent, natural gasoline division, to serve the Houston and Fort Worth regions.

H. A. van Karnebeek, Jr., managing director of Standard-Vacuum Petroleum Mij., with headquarters in The Hague, and **H. A. Gibbons,** general manager at Palembang, Sumatra, were in New York City recently attending company conferences.

George S. Berry, Sinclair Oil & Gas Co., Wichita Falls, Tex., has resigned to become an independent oil operator. He was employed by Sinclair for 25 years and formerly was in the Fort Worth office.

Franklin LeRoy Newcomb, design consultant specializing in equipment safety in the Esso engineering department, Standard Oil Development Co., has retired after nearly 32 years' service. He is one of the originators of metals and safety inspection on equipment of the refining industry.

SHIFTS—

Richard J. Carlton, refinery engineer, J. H. Huber Corp., Borger to Baytown, Tex.; **C. D. Mims,** engineer, Standard Oil Co. of Texas, Houston to Snyder, Tex.; **F. F. Hebert,** engineer, Humble Oil & Refining Co., Point-a-la-Hache to New Orleans; **William R. Bohon,** engineer, Smackover, Ark., to Alvin, Tex.; **James T. Dorland,** engineer, Ashland Oil & Refining Co., Salem, Ill., to Henderson, Ky.; **Joseph R. Ault,** engineer, Carter Oil Co., Brandon, Miss., to Tallulah, La.; **L. P. Bristley, Jr.,** geologist, Gulf Research & Development Co., Hazelhurst to Vicksburg, Miss.; **Frank N. Blanchard, Jr.,** geologist, American Republics Corp., Jackson, Miss., to Shreveport; **Paul V. Haines,** Midwestern Construction Co., Pottstown to Forty Fort, Pa.

P. E. Cosper, Skelly Oil Co., Trinidad, Colo., to Lindsay, Okla.; **Keith E. Bohres,** engineer, Skelly Oil Co., Walnut, Kans., to Skellytown, Tex.; **Ross M. Acher,** superintendent, The Texas Co., Seminole to Maysville, Okla.; **Lurl S. Ostrander,** superintendent, Rocky Mountain Drilling Co., Avenal to Oildale, Calif.; **W. P. Larkin,** superintendent, McCarthy Drilling Co., Bakersfield, Calif., to Houston; **Thomas E. Weaver,** engineer, Tide Water Associated Oil Co., Bakersfield to Fellows, Calif.; **Gordon Kiddoo,** refinery engineer, Laguna Beach, Calif., to Stamford, Conn.; **P. M. Thompson,** The Texas Co., Carlsbad, N. M., to Grand Junction, Colo.; **Lee E. McDuff,** engineer, Transcontinental Gas Pipe Line Corp., Crosbyton, Tex., to St. Francisville, La.

Norman Edge, geologist, Continental Oil Co., Gonzales to Kenedy, Tex.; **Roy E. Hogan,** engineer, Phillips Petroleum Co., Alvin, Tex., to Pauls Valley, Okla.; **Wesley E. Davis,** geologist, The Texas Co., Bellaire to Midland, Tex.; **Wallace B. Johnson,** engineer, Atlantic Refining Co., Denver City to Odessa, Tex.; **R. D. McNeme, Jr.,** engineer, Humble Oil & Refining Co., Houston to Wichita Falls, Tex.; **Don R. Reese,** engineer, Phillips Petroleum Co., Houston to West Jackson, Miss.; **Bennie F. Duncan,** engineer, Otis Pressure Control, Inc., Longview, Tex., to Houma, La.; **A. E. Straub,** engineer, Cities Service Oil Co., Odessa, Tex., to Bartlesville, Okla.

Ross M. Glaze, Jr., geologist, Lubbock to Muleshoe, Tex.; **I. A. Parmer,** superintendent, Coronado Oil Co. of Delaware, Lubbock to Lefors, Tex.; **Elliott H. Powers,** geologist, Gulf Oil Corp., Midland, Tex., to Fort Worth; **E. B. Woodell,** superintendent, Humble Oil & Refining Co., Monroe City to Katy, Tex.; **W. W. Phillips,** superintendent, Humble Oil & Refining Co., Overton to Gladewater, Tex.

Jack H. Jeter, superintendent, D. M. Ross Drilling Co., Wichita Falls to Throckmorton, Tex.; **C. K. Taylor,** refining superintendent, Gilcrease Oil Co., Arabia, La., to Big Spring, Tex.; **Norton E. Fincher,** engineer, Humble Oil & Refining Co., New Iberia, La., to New Orleans.

Thomas E. Goebel, engineer, Cole Drilling Co., Abilene, Tex., to Maracaibo, Venezuela; **Alvin V. White,** engineer, Union Sulphur Co., Inc., Austin, Tex., to Sulphur, La.; **A. Ferd Morris,** geologist, Cities Service Oil Co., Houston to Calgary, Alta.; **James N. Wilson,** engineer, Seismograph Service Corp., Kermit, Tex., to Erie, Colo.; **H. D. Pennel,** geologist, American Republics Corp., Midland to San Angelo, Tex.; **G. E. Conner, Jr.,** engineer, Humble Pipe Line Co., Odessa to Silver, Tex.

DEATHS

Charles Schepling, 39, and **William Emerick,** 49, employed in the oil-distillation units department at Esso Standard Oil Co.'s Baltimore refinery, were killed in an explosion and fire at the plant July 21.

Charles Major O'Dor, 61, pumper for Simpson-Fell Oil Co. at Alma, Okla., was killed in an automobile accident near Duncan, Okla., July 19.

S. Edward Murphy, president of S. E. Murphy, Inc., oil brokerage firm, New York City, died July 18. He formerly was manager of the natural-gasoline division of Cities Service Oil Co. in Bartlesville, Okla.

Cecil A. Seaver, 47, general superintendent of Gas Service Co. at Nowata, Okla., died July 17.

Frank V. Moore, 59, supervisor of refinery compound, Humble Oil & Refining Co. at Baytown, Tex., died July 16.

Leslie B. Lane, 57, employe in the yield and cost department, Esso Standard Oil Co.'s Baton Rouge refinery, died recently.

John J. Gavin, 68, former compounding plant foreman at Esso Standard Oil Co.'s Bayonne, N. J., refinery, died recently.

Joseph Stephen Zuccaro, 56, independent oil operator, died in Natchez, Miss., July 18.

A. T. Beazley, director and general manager of Lobitos Oilfields, Ltd., London, died July 19.

Midyear REPORT

Economics

Demand forecasts indicate sharp pickup in oil heating needs if normal weather prevails. Refined product stocks are expected to be in better balance by end of year. This will be reflected in increased crude runs by refiners; perhaps some reduction in crude stocks; and probably some increase in production rates from low levels of July. Production and refining activity in last half may reverse first-half pattern. First-half production and refinery runs started at high levels, decreased steadily. Last half may see steady pickup from July levels.

Drilling activity will probably be almost exactly same as first half, bringing 1949 totals to highest on record for total footage drilled, second highest for number of wells drilled. Cuts in 1949 drilling programs of large operators almost balanced by increases among smaller operators. Last half 1949 drilling will suffer only by comparison with record-smashing last half of 1948. Usual seasonal pattern of increased drilling in last half of year will not prevail in 1949.

Construction projects in pipe-line, natural-gas-processing, and refining divisions make up a long list, which in total account for very large investments. Low fuel-oil prices and competition for higher-octane gasoline markets expected to result in more modernization projects for many refiners.

Engineering

The Midyear Engineering Reference section appearing in this issue has been designed to fulfill a special purpose. It will permit the industry's technologists to take a look at some recent engineering and research accomplishments, and to see what is representative of the work being done, and the trends pointed to the future. To be found in this engineering section, for example, are laboratory and field test data for a new mud additive that is highly effective in combating lost circulation. Facts concerning the procedures, benefits, and problems in unitization are detailed. Oil reserves and secondary recovery are discussed, and a novel use of a new repressure-driving agent is suggested.

A critical analysis is made of the methods of determination of water dew point in hydrocarbon gases. One of the largest research programs on corrosion investigations is outlined, giving test results. Mechanical vibration of piping as induced by gas pressure pulsations is discussed. Design data pertaining to finned tube exchangers and condensers are presented. The engineering and design problems involved for one of the world's largest pipe lines are treated. Still other material covers the extensive investigations of the Committee on Oil Loss Prevention, Esso Standard Oil Co.: (1) Elimination and Control of Oil Losses, (2) Control of Product Stock Losses—Loading and Storage, (3) Loss Control in Petroleum Refineries.

Presented by THE OIL AND GAS JOURNAL

Footage Drilled During 1949 May Set New Record

by Charles J. Deegan

OPERATORS reporting on their drilling plans for the last half of 1949 have indicated they intend to drill 70,925,000 ft. of hole. Added to the 1949 first-half total of 67,172,000 ft. already drilled, this will bring the year's total footage to 138,097,000 ft. This would surpass 1948's all-time record on footage by 705,000 ft.

The forecast of drilling plans, as revised in mid-year, indicates that while many of the rumors and reports of curtailment of drilling programs by various large companies may be true, the over-all picture is surprisingly different. In number of wells to be drilled, the last half of 1949 will be almost exactly the same as the first half, 18,584 wells to come, against 18,519 drilled in the first half. On net balance for the year, the midyear revised forecast is that 37,103 wells will be drilled during the entire year. This compares with a January forecast for the year of 37,550 wells.

What happened was that the 27 large operators revised their January plans downward by about 20 per cent—from 10,489 wells for the entire year to

Table 1—Forecast of Last Half of 1949 Drilling Program

	Forecast last half 1949				Change from last half 1948			
	Total footage (000 ft.)	Total wells	Wildcat wells	Field wells	Total footage (000 ft.)	Total wells	Wildcat wells	Field wells
Alabama	69	12	10	2	— 1	— 2	— 2	0
Arkansas	415	97	30	67	— 293	— 69	— 24	— 45
California	5,500	1,100	260	840	64	— 340	— 6	— 334
Colorado	288	48	30	18	— 223	— 48	— 1	— 47
Florida	80	10	8	2	— 6	— 5	— 6	1
Illinois	2,665	1,050	300	750	—1,005	— 359	— 78	— 281
Indiana	1,068	555	208	347	— 102	— 59	13	— 72
Kansas	5,460	1,687	202	1,485	— 416	— 120	— 78	— 42
Kentucky	815	485	37	448	— 77	— 20	— 39	19
Louisiana	7,790	1,358	184	1,174	1,688	60	7	53
Northern	2,660	775	63	712	319	— 97	— 5	— 92
Southern	5,130	583	121	462	1,369	157	12	145
Michigan	1,325	544	128	416	115	— 10	— 50	40
Mississippi	1,190	151	40	111	— 593	— 91	— 30	— 61
Montana	490	166	51	115	9	— 41	28	— 69
New Mexico	1,345	265	26	239	57	— 42	— 18	— 24
New York	400	354	2	352	— 569	— 316	2	— 318
Ohio	1,320	576	7	569	— 486	— 172	— 19	— 153
Oklahoma	8,580	2,285	422	1,863	28	— 28	0	— 28
Pennsylvania	1,870	825	9	816	— 913	— 892	6	— 898
Texas	27,300	6,319	1,319	5,000	—2,110	— 515	— 92	— 423
North Central	6,980	2,285	525	1,760	557	95	17	78
West	7,100	1,490	170	1,320	—1,703	— 300	— 19	— 281
Panhandle	1,650	515	14	501	486	141	6	135
Eastern	1,540	292	78	214	— 437	— 85	3	— 88
Gulf Coast	5,920	921	216	705	— 547	— 104	— 90	— 14
Southwest	4,110	816	316	500	— 466	— 262	— 9	— 253
Utah	150	30	15	15	118	20	5	15
West Virginia	1,146	334	30	304	— 120	— 138	7	— 145
Wyoming	1,558	285	79	206	— 65	— 89	8	— 97
Miscellaneous	101	48	40	8	5	— 22	— 4	— 18
Total United States	70,925	18,584	3,437	15,147	—4,895	—3,298	—371	—2,927
27 Large operators	22,790	4,229	557	3,672	(*)	(*)	(*)	(*)
All other	48,135	14,355	2,880	11,475	(*)	(*)	(*)	(*)

*Not available.

TABLE 2 MIDYEAR REVISED 1949 DRILLING FORECAST BY TYPE OF OPERATOR

	27 large operators			All other operators			Whole industry		
	1949 revised program	1949 original program	1948 actually drilled	1949 revised program	1949 original program	1948 actually drilled	1949 revised program	1949 original program	1948 actually drilled
Wildcat wells	1,065	1,381	1,312	5,925	5,672	5,565	6,990	7,053	6,877
Field wells	7,377	9,108	9,469	22,736	21,389	23,432	30,113	30,497	32,901
Total wells	8,442	10,489	10,781	28,661	27,061	28,997	37,103	37,550	39,778
Total footage	43,932,000	50,740,000	49,073,000	94,165,000	86,792,000	88,319,000	138,097,000	137,532,000	137,392,000
Change in wildcats vs. '48	— 247	+ 69		+360	+ 107		+ 113	+ 176	
Change in field wells vs. '48	—2,092	—361		—696	—2,043		—2,788	—2,404	
Change in total wells vs. '48	—2,339	—292		—336	—1,936		—2,675	—2,228	
Per cent of U. S. wildcats	15.2%	19.7%		84.8%	80.3%	80.9%	100%	100%	100%
Per cent of U. S. field wells	24.5%	29.8%		75.5%	70.2%	71.2%	100%	100%	100%
Per cent of U. S. total wells	22.8%	27.9%		77.2%	72.1%	72.8%	100%	100%	100%
Per cent of U. S. total footage	31.8%	37.9%		68.2%	62.1%	64.4%	100%	100%	100%

TABLE 3—DRILLING FORECAST WILDCATTING ACTIVITY

	Last half 1949 forecast	First half 1949 actual	Change
North Central Texas	525	547	— 22
Oklahoma	422	387	+ 35
Southwest Texas	316	356	— 40
Illinois	300	305	— 5
California	260	269	— 9
Texas Gulf Coast	216	285	— 69
Indiana	208	219	— 11
Kansas	202	245	— 43
Louisiana	184	144	+ 40
West Texas	170	166	+ 4
Subtotal	2,803	2,923	—120
All other areas	634	630	+ 4
Total United States	3,437	3,553	—116

8,442 wells. But the smaller operators increased their plans from 27,061 wells planned for the year last January, to 28,651 in the midyear revision. A cut of 2,047 wells by large operators was partially balanced by an increase of 1,600 wells by small operators, leaving the year's total 447 wells, or slightly more than 1 per cent down from the January plans.

This is a far different picture from some of the pessimistic rumors that have been current in many places. On the other hand, the 1949 pattern of practically the same amount of drilling in the last half of the year as in the first half is in contrast to the normal pattern. Normally there are more wells drilled in the last half of a year than in the first 6 months. This is a seasonal factor, partly accounted for by weather conditions.

By comparison with the second half of 1948, the last half of 1949 will be down on all counts. Total footage drilled will be off 6.5 per cent, total wells off 15.1 per cent; made up of a decrease of 9.7 per cent in wildcats, and 16.2 per cent in field wells. Comparisons made with the second half of 1948, an all-time high period, will inevitably show decreases. (See Table 1). But, except for that one period, the last half of 1948, the activity during the last half of 1949 should make a favorable showing in comparison with any other 6-month period.

Because the last half of 1949 is going to check so closely with the first half, Tables 3, 4, and 5, which highspot various phases, are all made to show a comparison of the last-half forecast with the first-half actual. Table 6 is a completely detailed comparison of the forecast and the actual results of the first 6 months. Table 7 shows a revised program for the year as compared to the January program. The revised program represents the first 6 months' actual completions plus the last-half forecast. While there are many shifts in the details, the totals show that on net balance there has been very little change in the outlook since last January.

When the number of wells goes down, but the footage goes up even slightly, there is definitely indicated a trend toward deeper wells. Both large and small operators seem to follow this trend. The effect is sufficient to indicate that 1949 will probably see a new record established for footage drilled.

The operators seem to feel the need for an aggressive exploration campaign, as wildcat drilling is less affected than field wells. The prospects are that even though wildcat drilling in the last half of 1949 will be off 9.7 per cent when compared with the record-breaking last half of 1948, the total for the year 1949 will surpass 1948's all-time record for the full year. The small operators will drill almost 85 per cent of the year's wildcat completions.

The 27 large operators are still going to be the ones to drill most of the deep wells. The 4,229 wells they have scheduled for the last half of this year will have an average depth of 5,389 ft. This is more than 1,000 ft. deeper, on an average, than the 14,355 wells the smaller operators have scheduled. The average depth of the wells to be drilled by the small operators is only 3,353 ft.

TABLE 4—DRILLING FORECAST—AREAS WITH OVER 1,000 WELLS SCHEDULED

	Last half 1949 forecast	First half 1949 actual	Change
Oklahoma	2,285	2,051	+ 234
North Central Texas	2,285	2,169	+ 116
Kansas	1,687	1,485	+ 202
West Texas	1,490	1,585	— 95
Louisiana	1,358	1,014	+ 344
California	1,100	1,345	—245
Illinois	1,050	1,177	—127
Subtotal	11,255	10,826	+ 429
All other areas	7,329	7,693	—364
Total United States	18,584	18,519	+ 65

TABLE 5—DRILLING FORECAST—AREAS WITH OVER THREE MILLION FEET SCHEDULED
(In thousands of feet)

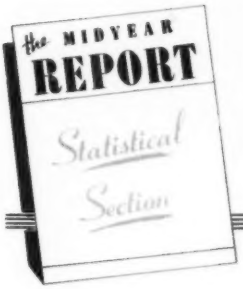
	Last half 1949 forecast	First half 1949 actual	Change
Oklahoma	8,580	7,370	+ 1,210
Louisiana	7,790	5,796	+ 1,994
West Texas	7,100	8,108	—1,008
North Central Texas	6,980	6,368	+ 612
Gulf Coast Texas	5,920	6,118	— 198
California	5,500	5,414	+ 86
Kansas	5,460	4,806	+ 654
Southwest Texas	4,110	4,553	— 443
Subtotal	51,440	48,533	+ 2,907
All other areas	19,485	18,639	+ 846
Total United States	70,925	67,172	+ 3,753

TABLE 6—LAST HALF 1949 DRILLING FORECAST VS. FIRST HALF 1949 DRILLED

	Total wells			Total footage (thou. feet)			Wildcat wells			Field wells		
	Last half forecast	First half drilled	Change	Last half forecast	First half drilled	Change	Last half forecast	First half drilled	Change	Last half forecast	First half drilled	Change
Alabama	12	6	+ 6	69	33	+ 36	10	6	+ 4	2	0	+ 2
Arkansas	97	144	— 47	415	594	— 179	30	30		67	114	— 47
California	1,100	1,345	—245	5,500	5,414	+ 86	260	269	— 9	840	1,076	—236
Colorado	48	37	+ 11	288	173	+ 115	30	17	+ 13	18	20	— 2
Florida	10	13	— 3	80	100	— 20	8	11	— 3	2	2	
Illinois	1,050	1,177	—127	2,665	3,002	— 337	300	305	— 5	750	872	—122
Indiana	555	578	— 23	1,068	1,112	— 44	208	219	— 11	347	359	— 12
Kansas	1,687	1,485	+202	5,460	4,806	+ 654	202	245	— 43	1,485	1,240	+245
Kentucky	485	410	+ 75	815	742	+ 73	37	54	— 17	448	356	+ 92
Louisiana	1,358	1,014	+344	7,790	5,796	+1,994	184	144	+ 40	1,174	870	+304
Northern	775	538	+237	2,650	1,730	+ 920	63	46	+ 17	712	492	+220
Southern	583	476	+107	5,130	4,066	+1,064	121	98	+ 23	462	378	+ 84
Michigan	544	445	+ 99	1,325	983	+ 342	128	169	— 41	416	276	+140
Mississippi	151	179	— 28	1,190	1,289	— 99	40	58	— 18	111	121	— 10
Montana	166	128	+ 38	490	311	+ 179	51	19	+ 32	115	109	+ 6
New Mexico	265	271	— 6	1,345	1,256	+ 89	26	32	— 6	239	239	0
New York	354	432	— 78	490	530	— 130	2	0	+ 2	352	432	— 80
Ohio	576	524	+ 52	1,320	1,202	+ 118	7	22	— 15	569	502	+ 67
Oklahoma	2,285	2,051	+234	8,580	7,370	+1,210	422	387	+ 35	1,863	1,664	+199
Pennsylvania	825	1,085	—260	1,870	1,753	+ 117	9	2	+ 7	816	1,083	—267
Texas	6,319	6,501	—282	27,300	28,470	—1,170	1,319	1,439	—120	5,000	5,152	—162
North Central	2,285	2,169	+116	6,980	6,368	+ 612	525	547	— 22	1,760	1,622	+138
West	1,490	1,585	— 95	7,100	8,108	—1,008	170	166	+ 4	1,320	1,419	— 99
Panhandle	515	504	+ 11	1,650	1,576	+ 74	14	3	+ 11	501	501	0
Eastern	292	345	— 53	1,540	1,747	— 207	78	82	— 4	214	263	— 49
Gulf Coast	921	980	— 59	5,820	6,118	— 298	216	285	— 69	705	695	+ 10
Southwest	816	1,018	—202	4,110	4,553	— 443	316	356	— 40	500	662	—162
Utah	30	21	+ 9	150	94	+ 56	15	5	+ 10	15	16	— 1
West Virginia	334	239	+ 95	1,146	726	+ 420	30	13	+ 17	304	226	+ 78
Wyoming	285	282	+ 3	1,558	1,308	+ 250	79	63	+ 16	206	219	— 13
Miscellaneous	48	52	— 4	101	108	— 7	40	44	— 4	8	8	0
Total United States	18,584	18,519	+ 65	70,925	67,172	+3,753	3,437	3,553	—116	15,147	14,966	+181
27 large operators	4,229	4,213	+ 16	22,790	21,138	+1,652	555	508	+ 49	3,672	3,705	— 33
All other operators	14,355	14,306	+ 49	48,135	46,034	+2,101	2,880	3,045	—165	11,475	11,261	+214

TABLE 7—INDUSTRY'S REVISED 1949 DRILLING PROGRAM IN MIDYEAR COMPARED TO ORIGINAL 1949 PROGRAM LAST JANUARY

	Total wells			Total footage (thou. feet)			Wildcat wells			Field wells		
	Revised program	Jan. program	Change	Revised program	Jan. program	Change	Revised program	Jan. program	Change	Revised program	Jan. program	Change
Alabama	18	27	— 9	102	155	— 53	16	25	— 9	2	2	
Arkansas	241	224	+ 17	1,009	1,065	— 56	60	83	— 23	181	141	+ 40
California	2,445	2,607	— 162	10,914	9,840	+1,074	529	502	+ 27	1,916	2,105	— 189
Colorado	85	142	— 57	461	800	— 339	47	71	— 24	38	71	— 33
Florida	23	33	— 10	180	179	+ 1	19	31	— 12	4	2	+ 2
Illinois	2,227	2,503	— 276	5,667	6,550	— 883	605	653	— 48	1,622	1,850	— 228
Indiana	1,133	1,000	+ 133	2,180	1,900	+ 280	427	245	+182	706	755	— 49
Kansas	3,172	3,527	— 355	10,266	10,810	— 544	447	542	— 95	2,725	2,985	— 260
Kentucky	895	1,103	— 208	1,557	1,710	— 153	91	176	— 85	804	927	— 123
Louisiana	2,372	2,041	+ 331	13,586	12,550	+1,036	328	350	— 22	2,044	1,691	+ 353
Northern	1,313	1,080	+ 233	4,390	3,880	+ 510	109	109		1,204	971	+ 233
Southern	1,059	961	+ 98	9,196	8,670	+ 526	219	241	— 22	840	720	+ 120
Michigan	989	1,180	— 191	2,308	2,740	— 432	297	370	— 73	692	810	— 118
Mississippi	330	407	— 77	2,479	3,200	— 721	98	108	— 10	232	299	— 67
Montana	294	371	— 77	801	925	— 124	70	56	+ 14	224	315	— 91
New Mexico	536	569	— 33	2,601	2,720	— 119	58	56	+ 2	478	513	— 35
New York	786	885	— 99	930	1,330	— 400	2	0	+ 2	784	885	— 101
Ohio	1,100	1,120	— 20	2,522	3,000	— 478	29	40	— 11	1,071	1,080	— 9
Oklahoma	4,336	3,825	+ 511	15,950	14,000	+1,950	809	685	+124	3,527	3,140	+ 387
Pennsylvania	1,910	2,225	— 315	3,623	3,700	— 77	11	38	— 27	1,899	2,187	— 288
Texas	12,920	12,042	+ 878	55,770	54,280	+1,490	2,758	2,670	+ 88	10,162	9,372	+ 790
North Central	4,454	3,515	+ 939	13,348	10,300	+3,048	1,072	945	+127	3,382	2,570	+ 812
West	3,075	3,040	+ 35	15,208	15,270	— 62	336	280	+ 56	2,739	2,760	— 21
Panhandle	1,019	475	+ 544	3,226	1,500	+1,726	17	18	— 1	1,002	457	+ 545
Eastern	637	815	— 178	3,287	4,360	—1,073	160	205	— 45	477	610	— 133
Gulf Coast	1,901	2,350	— 449	12,038	15,250	—3,212	501	610	—109	1,400	1,740	— 340
Southwest	1,834	1,847	— 13	8,863	7,600	+1,063	672	612	+ 60	1,162	1,235	— 73
Utah	51	37	+ 14	244	175	+ 69	20	23	— 3	31	14	+ 17
West Virginia	573	895	— 322	1,872	2,530	— 658	43	82	— 39	530	813	— 283
Wyoming	567	675	— 108	2,866	3,180	— 314	142	180	— 38	425	495	— 70
Miscellaneous	100	112	— 12	209	193	+ 16	84	67	+ 17	16	45	— 29
Total United States	37,103	37,550	— 447	138,097	137,532	+ 565	6,990	7,053	— 63	30,113	30,497	— 384
27 large operators	8,442	10,489	—2,047	40,932	50,740	—6,808	1,065	1,381	—316	7,377	9,108	—1,731
All others	28,661	27,061	+1,600	94,165	86,792	+7,373	5,925	5,672	+ 253	22,736	21,389	+1,347



18,519 Wells, 67 Million Feet of Hole Drilled So Far This Year

by John C. Casper

OPERATORS set a new drilling record in the first half of this year with the completion of 18,519 wells compared with 17,896 in the same months last year. Total hole drilled amounted to 67,172,000 ft., a gain of 9.1 per cent compared with the 3.5 per cent increase in number of completions.

The volume of drilling in the first half was influenced by demand for petroleum products and particularly by changes in demand for specialty crudes. Decreased demand for lubricating oils resulted in sharp reductions in drilling for the Appalachian region where the wells are relatively shallow. Completions for Pennsylvania, New York, West Virginia, and Ohio were 855 wells below last year. The remainder of the country had an increase of 1,478 wells or 10 per cent. Total footage for all areas other than eastern was up 13.2 per cent.

Wildcat wells increased 484 to a total of 3,553 for the 6-month period. This represents a gain of 15.8 per cent in completions compared with an increase of 13.8 per cent in wildcat footage, and sets new records for completions and footage.

Development completions gained only 0.9 per cent but development footage was up 7.9 per cent. This indicates a gain in average well depth which resulted from the general trend toward deeper drilling and from decreased activity in the shallow eastern area.

Texas operators completed 6,601 wells for a gain of 21.9 per cent but commitments for many of these wells had been made before the severe cuts in production allowables. The Texas increase more than offset the loss from those states where drilling activity was below last year.

Summary of Completed Wells, First 6 Months 1949

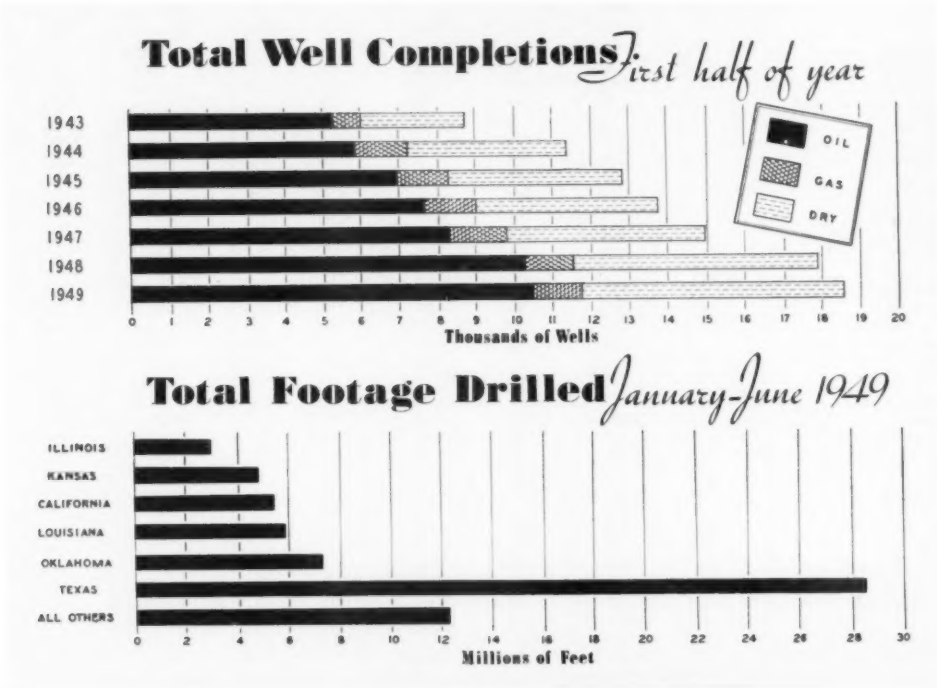
	Total comp.	Oil	Gas	Dry	Service	Footage (thou. ft.)	Total Jan.-June 1948
Alabama	6	0	0	6	0	33	7
Arkansas	144	86	2	54	2	594	135
California	1,345	1,053	11	281	0	5,414	1,436
Colorado	37	14	0	23	0	173	111
Florida	13	3	0	10	0	100	11
Illinois	1,177	638	2	535	2	3,002	1,029
Indiana	578	240	8	328	2	1,112	468
Kansas	1,485	810	84	581	10	4,806	1,477
Kentucky	410	167	93	146	4	742	403
Louisiana	1,014	671	74	268	1	5,796	1,027
North	538	360	63	114	1	1,730	682
South	476	311	11	154	0	4,066	345
Michigan	445	189	6	233	17	983	341
Mississippi	179	86	3	89	1	1,289	186
Montana	128	64	27	37	0	311	138
New Mexico	271	182	29	60	0	1,256	299
New York	432	218	0	0	214	530	674
Ohio	524	167	146	192	19	1,202	645
Oklahoma	2,051	1,160	117	757	17	7,370	1,980
Pennsylvania	1,085	535	98	16	436	1,753	1,442
Texas	6,601	3,965	424	2,188	24	28,470	5,417
Eastern (5, 6, 6-P)	345	190	31	121	3	1,747	254
North Central (7-B, 9)	2,169	1,099	27	1,024	19	6,368	1,660
Panhandle (10)	504	280	194	30	0	1,576	292
West (7-C, 8)	1,585	1,348	16	221	0	8,108	1,461
Southwest (1, 4)	1,018	500	63	454	1	4,553	879
Gulf Coast (2, 3)	980	548	93	338	1	6,118	871
Utah	21	13	1	7	0	94	8
West Virginia	239	34	174	31	0	726	374
Wyoming	282	164	4	114	0	1,308	210
Miscellaneous	52	6	5	41	0	108	78
Jan.-June 1949	18,519	10,465	1,308	5,997	749	67,172	
Jan.-June 1948	17,896	10,299	1,294	5,227	1,076	61,571	

DEVELOPMENT WELL COMPLETIONS, FIRST 6 MONTHS

	Comp.	Oil	Gas	Dry and service	Footage (thou. ft.)
Alabama	0	0	0	0	0
Arkansas	114	84	2	28	492
California	1,075	1,029	6	41	4,418
Colorado	28	13	0	7	102
Florida	2	2	0	0	23
Illinois	872	589	2	281	2,274
Indiana	359	213	7	139	679
Kansas	1,240	766	80	394	3,953
Kentucky	356	160	92	104	637
Louisiana	870	632	70	168	4,588
North	492	357	63	72	1,493
South	378	275	7	96	3,095
Michigan	276	174	5	97	629
Mississippi	121	82	2	37	689
Montana	109	63	26	20	249
New Mexico	239	176	29	* 34	1,089
New York	432	218	0	214	530
Ohio	502	166	144	192	1,119
Oklahoma	1,664	1,076	106	482	5,769
Pennsylvania	1,083	535	97	451	1,738
Texas	5,162	3,736	368	1,058	21,574
Eastern	263	185	28	50	1,345
North Central	1,622	1,012	18	592	4,406
Panhandle	501	279	194	28	1,554
West	1,419	1,320	14	85	7,070
Southwest	662	457	48	157	3,105
Gulf Coast	695	483	66	146	4,094
Utah	16	13	1	2	64
West Virginia	226	33	168	25	645
Wyoming	219	146	4	69	985
Miscellaneous	8	2	3	3	19
Jan.-June 1949	14,966	9,908	1,212	3,846	52,465
Jan.-June 1948	14,027	9,820	1,164	3,043	48,642

WILDCAT COMPLETIONS, FIRST 6 MONTHS 1949

	Comp.	Oil	Gas	Dry	Footage (thou. ft.)
Alabama	6	0	0	6	33
Arkansas	30	2	0	28	102
California	269	24	5	240	996
Colorado	17	1	0	16	71
Florida	11	1	0	10	77
Illinois	305	49	0	256	728
Indiana	219	27	1	191	433
Kansas	245	44	4	197	853
Kentucky	54	7	1	46	105
Louisiana	144	39	4	101	1,208
North	46	3	0	43	237
South	98	36	4	58	971
Michigan	169	15	1	153	354
Mississippi	58	4	1	53	400
Montana	19	1	1	17	62
New Mexico	32	6	0	26	167
New York	0	0	0	0	0
Ohio	22	1	2	19	83
Oklahoma	387	84	11	292	1,601
Pennsylvania	2	0	1	1	15
Texas	1,439	229	56	1,154	6,896
Eastern	82	5	3	74	402
North Central	547	87	9	451	1,962
Panhandle	3	1	0	2	22
West	166	28	2	136	1,038
Southwest	356	43	15	298	1,448
Gulf Coast	285	65	27	193	2,024
Utah	5	0	0	5	30
West Virginia	13	1	5	8	81
Wyoming	63	18	0	45	323
Miscellaneous	44	4	2	38	89
Jan.-June 1949	3,553	557	96	2,900	14,707
Jan.-June 1948	3,069	479	130	2,460	12,929



COMPLETIONS BY STATES—DEPTH CLASSIFICATIONS

	Under 2,500 ft.	2,500-5,000 ft.	5,000-7,500 ft.	7,500-10,000 ft.	10,000-12,500 ft.	Over 12,500 ft.
Alabama	1	3	1	0	0	1
Arkansas	36	70	15	23	0	0
California	482	481	219	98	52	13
Colorado	9	4	14	8	2	0
Florida	1	3	3	1	5	0
Illinois	408	769	0	0	0	0
Indiana	461	117	0	0	0	0
Kansas	186	1,294	5	0	0	0
Kentucky	310	98	2	0	0	0
Louisiana	372	114	143	196	160	29
North	358	59	73	31	17	0
South	14	55	70	165	143	29
Michigan	293	152	0	0	0	0
Mississippi	1	23	87	29	39	0
Montana	76	39	10	2	1	0
New Mexico	43	139	58	20	6	5
New York	432	0	0	0	0	0
Ohio	277	240	7	0	0	0
Oklahoma	534	963	364	54	33	3
Pennsylvania	1,020	63	1	1	0	0
Texas	1,611	2,810	1,386	622	160	12
Eastern	29	174	96	40	5	1
North Central	921	1,001	245	2	0	0
Panhandle	17	486	0	1	0	0
West	258	682	359	200	80	6
Southwest	301	243	347	112	15	0
Gulf Coast	85	224	339	267	60	5
Utah	2	14	4	1	0	0
West Virginia	96	126	15	2	0	0
Wyoming	18	164	62	18	17	3
Miscellaneous	36	13	2	1	0	0
Total U. S.	6,805	7,699	2,398	1,076	475	66

AVERAGE FOOTAGE, FIRST 6 MONTHS

	Wildcat	Development	All wells Jan.-June 1949	All wells Jan.-June 1948
Alabama	5,505	0	5,505	5,740
Arkansas	3,415	4,314	4,127	4,162
California	3,701	4,107	4,025	3,581
Colorado	4,170	5,114	4,680	6,455
Florida	7,032	11,574	7,731	6,167
Illinois	2,385	2,608	2,550	2,640
Indiana	1,977	1,890	1,923	1,824
Kansas	3,479	3,188	3,236	3,221
Kentucky	1,941	1,789	1,809	1,544
Louisiana	8,384	5,275	5,716	4,705
North	5,149	3,035	3,216	2,621
South	9,903	8,190	8,542	8,826
Michigan	2,098	2,277	2,209	2,267
Mississippi	6,890	7,350	7,201	8,217
Montana	3,291	2,280	2,430	2,455
New Mexico	5,217	4,555	4,633	4,394
New York	0	1,227	1,227	1,429
Ohio	3,769	2,230	2,295	2,624
Oklahoma	4,137	3,467	3,593	3,517
Pennsylvania	7,316	1,605	1,616	1,654
Texas	4,793	4,179	4,313	4,308
Eastern	4,901	5,115	5,064	5,533
North Central	3,587	2,716	2,936	2,945
Panhandle	7,362	3,103	3,128	3,043
West	6,254	4,983	5,116	4,534
Southwest	4,069	4,689	4,472	4,550
Gulf Coast	7,101	5,890	6,243	6,347
Utah	6,092	3,998	4,497	1,879
West Virginia	6,258	2,851	3,036	2,479
Wyoming	5,131	4,495	4,637	4,180
Miscellaneous	2,018	2,341	2,066	
Jan.-June 1949	4,139	3,506	3,627	
Jan.-June 1948	4,213	3,281		3,441

SERVICE WELL COMPLETIONS (BY MONTHS)

	Pennsylvania	New York	Other states	Total U. S.
January	88	53	16	157
February	83	42	12	137
March	66	35	14	115
April	90	34	9	133
May	46	23	18	87
June	63	27	30	120
Total	436	214	99	749

WELL COMPLETIONS BY MONTHS

Wildcat Completions

	Jan.	Feb.	Mar.	Apr.	May	June
Oil	90	64	103	100	88	112
Gas	14	10	19	17	14	22
Dry	485	375	462	459	536	583
Total	589	449	584	576	638	717

Development Completions

Oil	1,648	1,314	1,664	1,629	1,675	1,978
Gas	189	161	192	229	223	218
Dry	679	506	623	665	613	760
Total	2,516	1,981	2,479	2,523	2,511	2,956

Total Completions

Oil	1,738	1,378	1,767	1,729	1,763	2,090
Gas	203	171	211	246	237	240
Dry	1,164	881	1,085	1,124	1,149	1,343
Total	3,105	2,430	3,063	3,099	3,149	3,673

By Depth Classifications

Depth (ft.)						
Under 2,500	1,170	858	1,099	1,142	1,135	1,390
2,500-5,000	1,226	1,036	1,250	1,284	1,395	1,508
5,000-7,500	424	304	416	413	371	470
7,500-10,000	188	159	201	167	158	203
10,000-12,500	87	56	86	77	77	92
Over 12,500	10	6	11	16	13	10

SUMMARY OF DRILLING METHODS, FIRST 6 MONTHS

	Total comp.	Rotary comp.	Cable comp.
Alabama	6	6	0
Arkansas	144	144	0
California	1,345	1,345	0
Colorado	37	37	0
Florida	13	13	0
Illinois	1,177	984	193
Indiana	578	331	247
Kansas	1,485	1,110	375
Kentucky	410	226	184
Louisiana	1,014	1,014	0
North	538	538	0
South	476	476	0
Michigan	445	*77	368
Mississippi	179	179	0
Montana	128	83	45
New Mexico	271	*240	31
New York	432	0	432
Ohio	524	524	0
Oklahoma	2,051	1,618	433
Pennsylvania	1,085	0	1,085
Texas	6,601	6,396	205
Eastern	345	345	0
North Central	2,169	1,964	205
Panhandle	504	*504	0
West	1,585	*1,585	0
Southwest	1,018	1,018	0
Gulf Coast	980	980	0
Utah	21	16	5
West Virginia	239	0	239
Wyoming	282	280	2
Miscellaneous	52	20	32
Total	18,548	*14,672	3,876

*Incl. wells drilled by rotary and finished by cable tools.

DISTILLATE WELL COMPLETIONS (BY MONTHS)

	Texas	Louisiana	Other states	Total U. S.
January	11	11	7	29
February	10	9	4	23
March	11	16	5	32
April	15	9	3	31
May	12	7	4	23
June	16	18	1	35
Total	75	70	24	173

the MIDYEAR REPORT
Statistical Section

First-Half Production Shows Drop of 27 Million Barrels

by Polly DeArmond

TEXAS' first 6 months' production off 33,550,000 bbl. compared to first half of 1948; United States total off only 27,404,000 bbl. in same period. That very nearly summarizes the story of the industry's attempt to bring crude-oil production into balance with storage facilities plus demand, as the postwar drive to meet greatly increased consumer's requirements overshot the mark.

By early August 1948 it was apparent that stocks of refined products were in shape to meet the winter's requirements. *(See The Oil and Gas Journal, August 19, 1948, page 58.)* However, crude-oil stocks were still scraping along at bare minimum working levels. Beginning about mid-September, the buildup in crude stocks began and gained momentum rapidly to the end of the year.

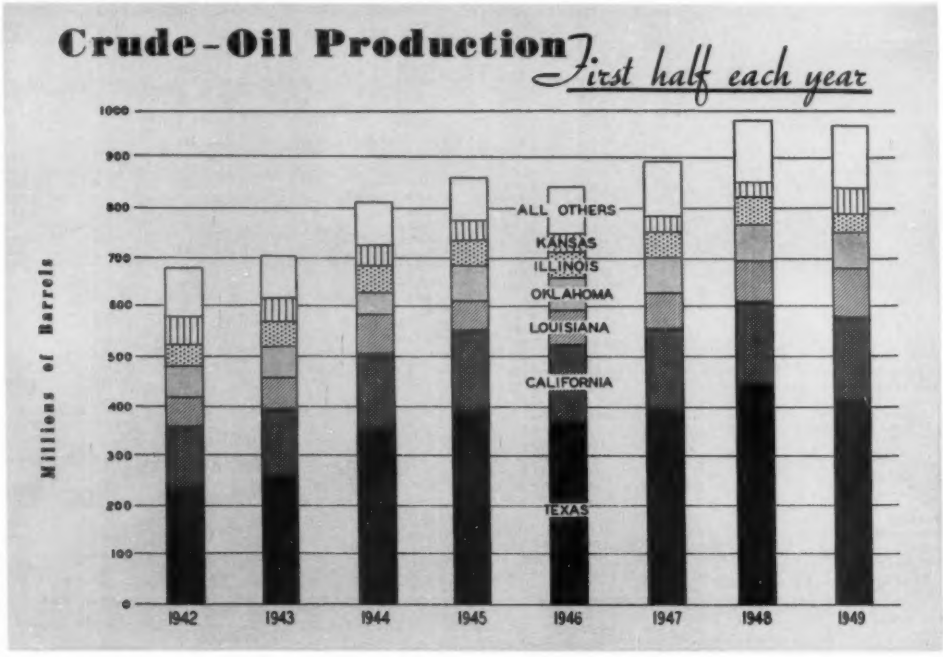
When demand for heating oils fell off due to an unusually warm winter in the large oil-consuming areas, and refiners began to cut down their crude-oil runs to stills. This reduced the consumption of crude oil, and with crude storage filling up fast, Texas began cutting down production.

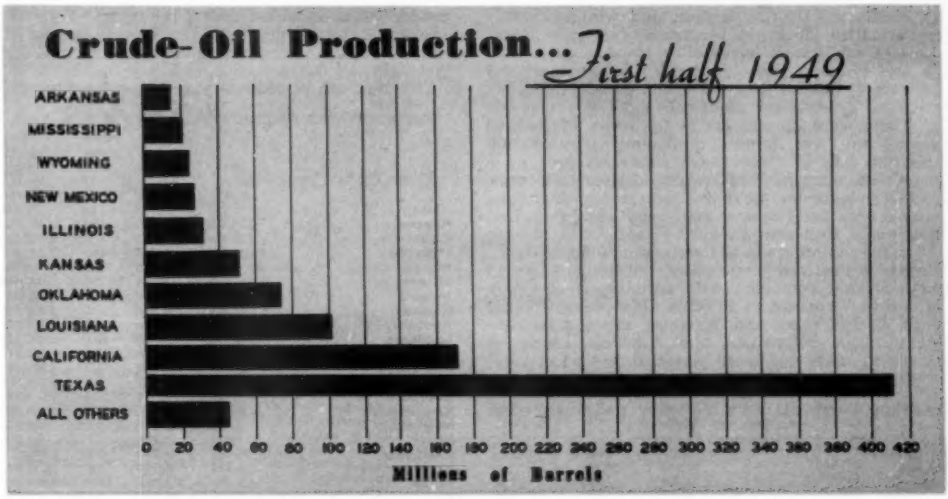
During the entire first half of 1948, crude stocks continued to rise, and production was cut back further and further. A continued high rate of imports added somewhat to the problem. Another factor was the tendency of distributors and consumers to liquidate stocks of refined products in their possession. With assurance of an ample supply of products, they foresaw the possibility of price cuts, and worked off their high-priced stocks. As a result, the demand indicated by shipments from refiners was probably below what was actually being consumed by the public.

Texas Bears Brunt of Cutback

Texas bore the brunt of this cutback in production. Compared to the first half of 1948, the first half of this year showed a decrease of 33,550,000 bbl. California also cut back some, showing a reduction of 2,034,000 bbl.; Kansas cut back 1,209,000 bbl.; while Wyoming and Mississippi, due to heavy cutbacks in low-gravity crudes, showed reductions of 3,467,000, and 2,732,000 bbl. respectively. In proportion to their total production, the Wyoming and Mississippi cuts were even heavier than that in Texas.

Louisiana, due in part to a rapid rate of increase in production throughout 1948, showed a substantial





increase in the first half of 1949 over the same period last year. Among other leading states, New Mexico, Illinois, and Oklahoma showed some gains. Colorado showed a substantial gain, but this was due to completion of additional pipe-line outlets for Rangely field in late 1948. For the remaining states, on net balance there was little change.

For the last half of 1949 there are signs that the trend may be almost the reverse of the first half. In the first half, production started off at a high level and tended steadily downward. In the last half, July may be the low point for the year, and December considerably higher, although perhaps not as high as January 1949.

There are some indications that distributors' and large consumers' stocks of refined products are

FIRST HALF 1949—ROCKY MOUNTAIN PRODUCTION RECORD

(Thousands of barrels)

State—	1949 First half	1948 First half	Change
Wyoming	22,965	26,432	—3,467
Colorado	11,649	8,218	+3,431
Montana	4,820	4,425	+ 395
Utah	69	2	+ 67
Total region	39,503	39,077	+ 426

FIRST HALF 1949 PRODUCTION—PRINCIPAL CHANGES

(Thousands of barrels)

State—	1949 First half	1948 First half	Change
Texas	411,324	444,874	—33,550
California	170,923	172,957	— 2,034
Louisiana	100,735	92,038	+ 8,697
Oklahoma	75,378	75,081	+ 297
Kansas	51,538	52,747	— 1,209
Illinois	31,553	31,052	+ 501
New Mexico	26,123	23,205	+ 2,918
Wyoming	22,965	26,432	— 3,467
Mississippi	20,192	22,924	— 2,732
All others net	60,022	56,847	+ 3,175
Total United States	970,753	998,157	—27,404

United States Production—First Half Year

	1949 Daily average (bbl.)	Thousands of barrels								
		1949	1948	1947	1946	1945	1944	1943	1942	1941
Alabama	1,171	212	234	171	191	79	8			
Arkansas	84,088	15,220	15,989	14,462	14,042	14,493	14,579	13,314	13,233	12,845
California	944,326	170,923	172,957	170,790	156,733	165,801	151,049	139,839	114,511	111,849
Colorado	64,359	11,649	8,218	6,770	4,548	1,832	1,354	1,085	1,057	781
Florida	1,309	237	160	73	27	11	8			
Illinois	174,326	31,553	31,052	33,434	37,684	37,492	39,085	41,919	57,871	60,954
Indiana	23,580	4,268	3,612	3,240	3,475	2,365	2,559	2,694	3,557	3,376
Kansas	284,741	51,538	52,747	50,294	45,444	48,480	49,553	54,712	45,100	37,612
Kentucky	23,519	4,257	4,380	4,687	5,203	4,959	4,232	3,467	2,114	2,420
Louisiana	556,547	100,735	92,038	73,081	68,870	64,246	64,285	59,897	57,880	55,325
Michigan	44,796	8,108	8,126	7,673	8,326	8,710	9,445	10,566	10,357	6,964
Mississippi	111,558	20,192	22,924	16,048	10,461	9,154	7,667	9,940	15,862	4,240
Montana	26,630	4,820	4,425	4,196	4,506	4,214	4,337	3,737	3,980	3,575
Nebraska	449	81	110	115	147	159	208	378	701	642
New Mexico	144,326	26,123	23,205	18,952	17,451	18,847	20,284	18,036	15,228	19,127
New York	11,956	2,164	2,310	2,359	2,425	2,263	2,363	2,555	2,692	2,499
Ohio	9,232	1,671	1,611	1,525	1,412	1,391	1,500	1,626	1,771	1,616
Oklahoma	416,453	75,378	75,081	68,709	67,748	67,501	60,703	61,812	71,615	75,875
Pennsylvania	32,536	5,889	6,297	6,270	6,480	6,279	7,296	8,089	9,015	8,117
Texas	2,272,508	411,324	444,874	389,477	371,596	391,750	355,771	257,977	236,694	243,220
West Virginia	7,348	1,330	1,311	1,346	1,448	1,450	1,570	1,707	1,787	1,681
Wyoming	126,879	22,965	26,432	20,963	19,175	18,299	15,667	15,965	15,499	14,588
Miscellaneous	619	116	64	91	24	27	24	27	32	31
Total United States		970,753	998,157	894,726	848,516	869,802	813,557	709,342	680,536	667,338
Total U. S. daily avg.	5,363,254	5,363,254	5,484,379	4,943,237	4,687,934	4,805,536	4,470,093	3,919,017	3,759,867	3,686,950

below normal. If this is true, and winter weather is normal in the heavy consuming centers, refinery runs of crude may have to be stepped up rapidly in late fall and early winter. If imports are held to recent levels, or reduced, this will mean an enlarged demand for crude oil.

There were no changes in the order of ranking among the five largest producing states during the first half of 1949. Texas continued first by a very wide margin. California, Louisiana, Oklahoma, and Kansas came next in that order. Louisiana widened its margin over Oklahoma somewhat, and now has a firm grip on third place.

In the second group of five large producing states, Illinois maintained sixth place, but an increase in New Mexico, combined with curtailment of heavy crudes in Wyoming, resulted in New Mexico taking over seventh place and Wyoming slipping back to eighth rank. Mississippi and Arkansas continued to occupy ninth and tenth places, same as last year.

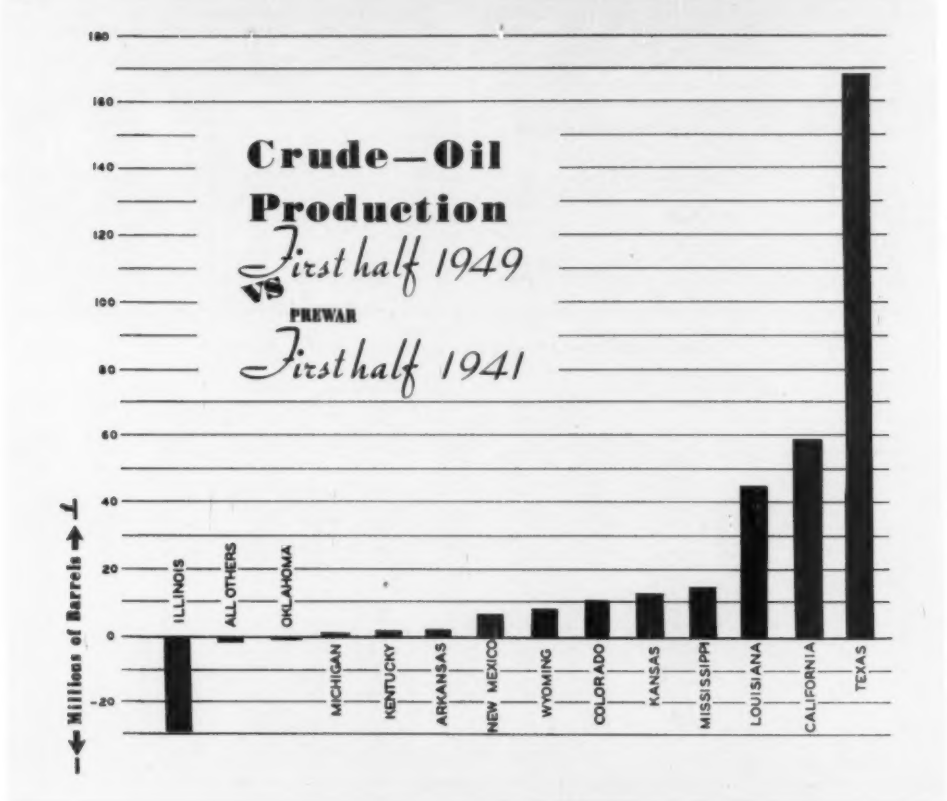
This is the first time Utah has had sufficient production to be ranked among the regular producers instead of being included in the miscellaneous. It now belongs in a group with Alabama, Florida, and Nebraska, all states producing less than 500,000 bbl. in the 6-month period.

EASTERN PART DISTRICT 2—FIRST HALF 1949 COMPARED TO PREWAR
(Thousands of barrels)

State—	1949	1940	Change
Illinois	31,553	78,745	—47,192
Indiana	4,268	1,732	+ 2,536
Kentucky	4,257	2,550	+ 1,707
Michigan	8,108	11,057	— 2,949
Ohio	1,671	1,501	+ 170
Total region	49,857	95,585	—45,728

UNITED STATES PRODUCTION—AVERAGE PER WELL

	1949 (thou. bbl.)	Prod. wells 7-1-49	Daily avg. bbl. per well	Cumulative prod. (thou. bbl.)
Alabama	212	34	34.4	1,686
Arkansas	15,220	3,576	23.5	770,515
California	170,923	25,375	37.2	8,172,511
Colorado	11,649	745	86.4	111,544
Florida	237	9	145.4	894
Illinois	31,553	30,875	5.6	1,396,508
Indiana	4,268	3,457	6.8	185,956
Kansas	51,538	28,490	10.0	1,927,321
Kentucky	4,257	14,770	1.6	238,019
Louisiana	100,735	10,342	53.8	2,311,119
Michigan	8,108	3,498	12.8	297,912
Mississippi	20,192	1,412	79.0	228,285
Montana	4,820	2,927	9.1	156,274
Nebraska	81	45	10.0	5,647
New Mexico	26,123	5,136	28.1	612,266
New York	2,164	17,827	0.7	169,614
Ohio	1,671	22,724	0.4	612,113
Oklahoma	75,378	53,825	7.7	5,961,915
Pennsylvania	5,889	56,771	0.5	1,119,435
Texas	411,324	114,807	19.8	12,633,175
West Virginia	1,330	16,661	0.4	439,315
Wyoming	22,965	4,798	26.4	829,505
Miscellaneous	116	88	7.3	1,912
Total U. S.	970,753	418,192	12.8	38,183,441



the MIDYEAR REPORT

Current Demand Indicates Need Of 5,210,000 Bbl. Daily

by E. T. Knight*

If normal winter weather prevails in northeastern United States, the author's figures show that the present period of abnormally low indicated demands for crude products will end in the fourth quarter of 1949. Jobbers' and dealers' fuel stocks, which are not included in Bureau of Mines data, have probably been reduced to a minimum. Actual consumer demand will therefore likely be reflected in changes in stocks included in Bureau of Mines data. The fourth quarter may mark the beginning of a normal rate of postwar growth in consumption of petroleum products.

FORECASTS—SUPPLY-DEMAND

	First half 1949*		Last half 1949		Heating season 10-1-1949 to 4-1-1950	
	Bbl. daily	Per cent increase over 1948	Bbl. daily	Per cent increase over 1948	Bbl. daily	Per cent increase over 1949
Crude production	5,158,210	—5.0	5,262,500	—5.8	5,589,000	1.6
Light-hydrocarbon prod.	415,320	6.4	425,000	4.6	437,480	3.3
Crude run to stills	5,354,800	—2.5	5,674,000	1.3	5,836,150	4.6
Total demand, all oils	6,061,830	—1.7	6,466,700	6.2	6,848,900	9.8
Total motor-fuel demand	2,538,280	7.3	2,755,000	6.1	2,531,270	5.9
Total middle-dist. demand	1,274,510	—9.8	1,367,000	14.0	1,891,950	21.6
Total residual demand	1,409,070	—4.7	1,385,000	4.4	1,551,980	5.8

*Four months actual; 2 months partly estimated.

FAILURE of the general economy thus far in 1949 to operate at levels as high as those anticipated when forecasts of 1949 demands and supply of petroleum and products were originally presented *(see The Oil and Gas Journal, January 27, 1949, page 190)* has made evident the need for reconsideration of these forecasts. Consideration must also be given to other unforeseeable conditions which have resulted in rates of demand for specific petroleum products markedly lower than were expected. An important example is the unusually warm weather during the early months of 1949 in the areas where large volumes of distillate fuels are consumed for heating purposes.

The new forecasts here presented are a combination of actual performance, as indicated by the Bureau of Mines for the first 4 months of the year; estimates of consumption of the four major petroleum products based upon available data reflecting trends in operations for May and June; and the current outlook for the next 9 months.

As a result of changes in method of reporting, some items of actual and forecasted 1949 operations are not comparable with 1948 data. These changes do not have a material effect on basic information, but do create some apparent statistical discrepancies.

*Petroleum economist, The Atlantic Refining Co.

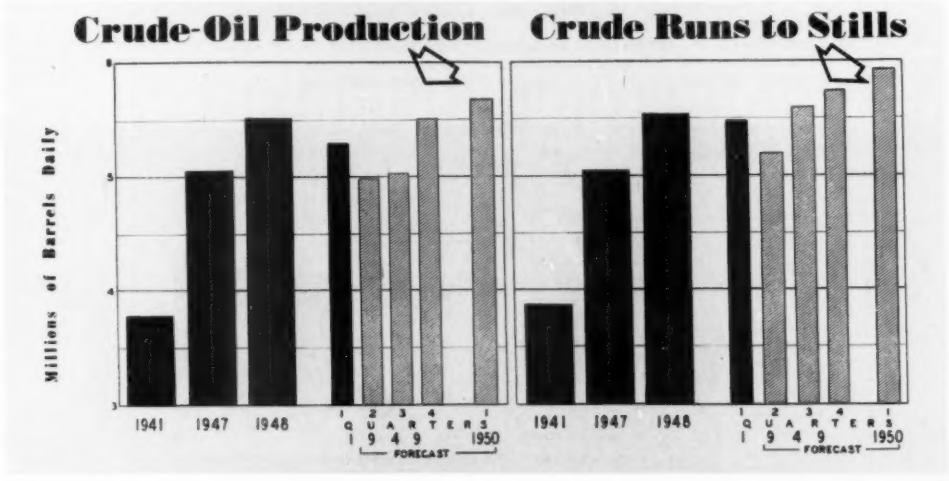


Table 1 indicates the extent to which the current outlook for domestic demands differs from the original forecast:

TABLE 1—DOMESTIC DEMAND FOR PETROLEUM PRODUCTS (Bbl. daily)

	Forecast 1-27-49	Per cent increase over 1948	Current forecast, year 1949	Per cent increase over 1948
Motor fuel	2,548,220	7.0	2,523,380	6.0
Kerosine	334,910	9.2	298,210	—2.7
Distillate fuel	1,074,820	15.5	962,290	3.6
Residual fuel	1,429,000	4.5	1,364,280	—0.3
All other and losses	825,730	6.4	745,220	—4.0
Total	6,212,680	7.7	5,893,380	2.3

The current forecasted demand for petroleum products indicates the need for an average crude-oil production rate during 1949 of 5,210,000 bbl. daily. That rate of production would be 298,200 bbl. daily below the 1948 rate and is based upon the conclusion that stocks of petroleum and products may be reduced 14 million barrels during the year. This is a reversal from 1948 operations when 107 million barrels of all oils were added to inventories. Some part of the 1948 increase was necessary to raise stocks from the low levels at the end of 1947 to levels which would permit the industry to operate at a higher degree of efficiency.

Stock Reduction During 1949

This forecast of a reduction in petroleum stocks during 1949, as compared to the accumulation of stocks throughout 1948, results in a required supply of all oils during this year approximately 191,800 bbl. daily below the previous year despite a forecasted increase of 136,600 bbl. daily in demands for all oils.

Discussion of the forecasts of domestic demand for the important petroleum products follows:

Motor fuel.—The demand for motor fuel, as forecast for the remainder of 1949 and the first quarter of 1950, considers that:

1. The number of passenger cars in use will continue to increase with no decline in the average mileage per vehicle.
2. Weather conditions will permit the normal operation of passenger vehicles.
3. Industrial demand for gasoline and naphtha will not be markedly greater than that of a year ago.
4. Truck and bus requirements for motor fuel will exceed 1948 demands by only 3.5 per cent.
5. The requirements of the agricultural industry during the coming months will be no greater than the expected seasonal increase.

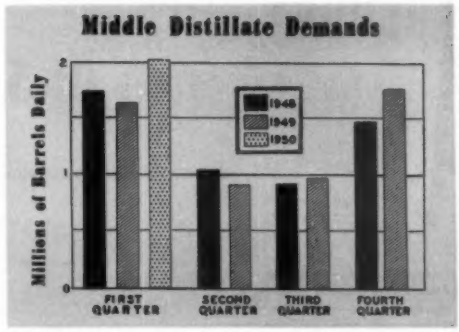


TABLE 2—DOMESTIC DEMAND FOR MOTOR FUEL (Bbl. daily)

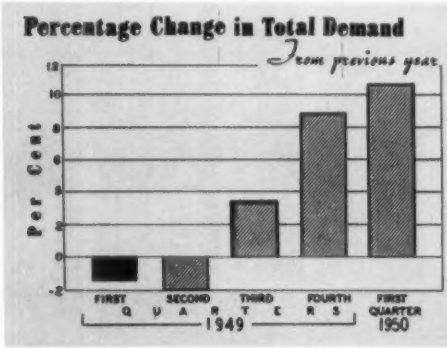
	1948	1949 Current forecast	Per cent over 1948
Passenger cars	1,385,350	1,508,880	9.0
Trucks and buses	558,230	571,350	3.5
Aviation industry	100,050	95,700	—4.4
Agricultural	185,000	191,000	3.3
Industry and misc.	151,700	156,450	3.8
Total	2,380,330	2,523,380	6.0

Kerosine.—The domestic demands for kerosine during the early months of 1949 were lower than the demands for the comparable months of 1948, and considerably below expectations. This resulted from two factors:

1. The warmer-than-normal weather during the heating season resulting in an appreciable drop in the consumption of kerosine for heating purposes.
2. The greater-than-expected reduction in stocks of kerosine held in jobber and distributor storage tanks. These stock changes are not reflected in the indicated demand shown by the Bureau of Mines monthly reports.

The demand for kerosine, as here presented for the 6 months ending March 31, 1950, is based on expected normal weather conditions and a continued growth in use of space heaters.

Distillate fuels.—In anticipation of installations of new oil burners at a rate markedly above 1948 and of a continued increase in demands for diesel fuel, domestic requirements for distillate fuels in the 6-month heating season ending March 31, 1950, are forecasted to be 24 per cent greater than in the 1948-49 heating season when demand was depressed by weather conditions.



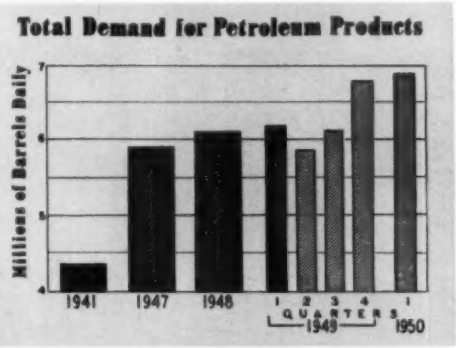


TABLE 3-

Demand and Supply of Petroleum Products 1949 (Barrels daily)

	First quarter		Second quarter		Third quarter		Fourth quarter		Year 1949	
Demand—	Actual	% Increase over 1948	Estimated	% Increase over 1948	Forecast	% Increase over 1948	Forecast	% Increase over 1948	Forecast	% Increase over 1948
Motor fuel	2,288,820	9.1	2,785,000	6.4	2,865,000	5.9	2,645,000	6.3	2,647,520	6.6
Domestic	2,157,050	5.6	2,660,000	6.4	2,740,000	5.9	2,530,000	5.9	2,523,380	6.0
Exports	131,770	79.9	125,000	6.5	125,000	4.7	115,000	16.5	124,140	21.5
Kerosine	382,170	—13.9	210,000	—11.4	222,000	1.0	422,000	15.8	308,910	—2.3
Domestic	371,370	—14.9	200,000	—11.8	210,000	1.0	412,000	15.8	298,210	—2.7
Exports	10,800	41.9	10,000	—3.5	12,000	0.9	10,000	14.2	10,700	10.8
Distillate fuels	1,260,900	—4.0	700,000	—16.0	760,000	7.9	1,330,000	20.4	1,012,230	2.4
Domestic	1,211,160	—3.7	650,000	—14.5	700,000	9.6	1,290,000	21.7	962,290	3.6
Exports	49,740	—10.2	50,000	—31.4	60,000	—8.4	40,000	—10.6	49,940	—16.2
Residual fuel	1,539,580	—2.8	1,280,000	—6.8	1,265,000	0.5	1,505,000	7.8	1,396,940	—0.4
Domestic	1,503,910	—3.8	1,250,000	—6.5	1,230,000	1.2	1,475,000	8.4	1,364,280	—0.3
Exports	35,670	70.6	30,000	—20.0	35,000	—18.8	30,000	—15.8	32,660	—4.7
Lubricants	116,010	—16.0	138,000	—0.9	141,000	9.2	136,000	2.0	132,830	—1.5
Domestic	80,200	—21.8	100,000	0.5	103,000	10.1	100,000	—2.0	95,870	—3.6
Exports	35,810	0.8	38,000	—4.2	38,000	6.7	36,000	15.3	36,960	4.1
Wax	9,270	—15.6	9,300	—2.0	9,600	30.6	9,800	12.3	9,500	4.1
Domestic	5,870	—24.8	6,300	—3.8	6,800	35.2	6,800	8.3	6,450	0.5
Exports	3,400	7.3	3,000	2.0	2,800	20.7	3,000	22.4	3,050	10.1
Asphalt and road oil,* domestic	73,410	—19.4	175,000	6.1	256,000	5.1	140,000	6.4	161,540	2.3
L.P.G. (including L.R.G.)*										
Domestic	191,970	2.2	170,000	7.0	175,000	6.6	210,000	10.0	186,760	6.4
Miscellaneous and losses†	284,280	—0.1	296,000	—2.5	296,000	—1.8	286,000	0.6	290,590	—1.0
Domestic	268,340	0.0	280,000	—3.0	280,000	—1.7	270,000	0.5	274,600	—1.1
Exports	15,940	—4.1	16,000	6.1	16,000	—3.3	16,000	2.9	15,990	0.2
Crude oil	80,770	—44.8	135,000	—26.9	140,000	—24.2	120,000	—17.8	119,120	—29.4
Domestic (as such and losses)‡	14,820	—70.4	20,000	—71.9	25,000	—67.5	20,000	—51.1	20,000	—66.5
Exports	65,950	—31.5	115,000	1.4	115,000	—4.7	100,000	—4.8	99,120	—8.9
Total demand, all oils	6,227,180	—1.4	5,898,300	—2.0	6,129,600	3.4	6,803,800	8.9	6,265,940	2.2
Domestic	5,878,100	—2.2	5,511,300	—1.8	5,725,800	3.8	6,453,800	9.3	5,893,380	2.3
Exports	349,080	13.1	387,000	—5.4	403,800	—2.7	350,000	2.3	372,560	1.0
Stock changes	+101,120		+81,700		—79,600		—248,800		—37,480	
Crude oil	+141,270		+25,000		—299,000		+36,000		—25,230	
Products	—40,150		+56,700		+219,400		—284,800		—12,250	
Supply—										
Total new supply	6,328,300	1.8	5,980,000	—6.2	6,050,000	—5.6	6,555,000	—1.8	6,228,460	—3.0
Imports	579,320	22.0	580,000	21.7	610,000	18.9	620,000	5.8	597,480	16.5
Crude oil	414,700	48.2	410,000	25.2	430,000	31.3	440,000	1.1	423,760	20.1
Products	164,620	—15.5	170,000	13.9	180,000	23.4	180,000	19.3	173,720	8.5
Domestic supply	5,748,980	0.2	5,400,000	—8.4	5,440,000	—7.8	5,935,000	—2.6	5,630,980	—4.7
Nat. gasoline and related products	420,690	7.2	410,000	5.6	415,000	7.3	435,000	2.0	420,200	5.5
Crude-oil production	5,328,290	—0.4	4,990,000	—9.4	5,025,000	—8.8	5,500,000	—2.9	5,210,780	—5.4
Crude run to stills	5,496,150	2.3	5,215,000	—7.1	5,589,000	0.8	5,759,000	1.7	5,515,700	—0.6
Crude oil transferred to products	24,800	—64.9	25,000	—63.9	25,000	—66.0	25,000	—70.2	24,950	—66.7

*Exports included in Miscellaneous Exports. †Miscellaneous products including shortages at refineries, etc. ‡Crude oil used on leases and miscellaneous losses.

TABLE 4

Demand and Supply of Petroleum Products 1949-50 (Barrels daily)

	First quarter, 1950		Six months ending March 31, 1950	
Demand—	Forecast	% Increase over 1949	Forecast	% Increase over previous year
Motor fuel	2,415,000	5.5	2,531,270	5.9
Domestic	2,295,000	6.4	2,413,800	6.1
Exports	120,000	—8.9	117,470	2.1
Kerosine	460,000	20.4	440,790	18.1
Domestic	450,000	21.2	430,790	18.5
Exports	10,000	—7.4	10,000	2.4
Distillate fuels	1,575,000	24.9	1,451,160	22.8
Domestic	1,530,000	26.2	1,408,680	24.2
Exports	45,000	—9.5	42,480	—10.0
Residual fuel	1,600,000	3.9	1,551,980	5.8
Domestic	1,570,000	4.3	1,521,980	6.3
Exports	30,000	—15.9	30,000	—15.8
Lubricants	126,000	8.6	131,050	5.0
Domestic	90,000	12.2	95,050	4.1
Exports	36,000	0.5	36,000	7.5
Wax	10,500	13.3	10,150	12.8
Domestic	7,000	19.2	6,900	13.5
Exports	3,500	2.9	3,250	11.3
Asphalts and road oil,* domestic	92,500	26.0	116,500	13.3
L.P.G. (including L.R.G.),* domestic	220,000	14.6	214,950	12.3
Miscellaneous and losses†	286,000	0.6	286,000	0.6
Domestic	270,000	0.6	270,000	0.6
Exports	16,000	0.4	16,000	1.7
Crude oil	110,000	36.2	115,050	1.2
Domestic (as such and losses)‡	20,000	35.0	20,000	—28.5
Exports	90,000	36.5	95,050	10.9
Total demand, all oils	6,895,000	10.7	6,848,900	9.8
Domestic	6,544,500	11.3	6,498,650	10.3
Exports	350,500	0.4	350,250	1.4
Stock changes	—155,000		—202,420	
Crude oil	- 70,000		- 52,800	
Products	—225,000		—255,220	
Supply—				
Total new supply	6,740,000	6.5	6,646,480	2.2
Imports	620,000	7.0	620,000	6.4
Crude oil	440,000	6.1	440,000	3.5
Products	180,000	9.3	180,000	14.2
Domestic supply	6,120,000	6.5	6,026,480	1.8
Nat. gasoline and related products	440,000	4.6	437,480	3.3
Crude-oil production	5,680,000	6.6	5,589,000	1.6
Crude run to stills	5,915,000	7.6	5,836,150	4.6
Crude oil transferred to products	25,000	0.8	25,000	—55.0

*Exports included in Miscellaneous Exports. †Miscellaneous products including shortages at refineries, etc. ‡Crude oil used on leases and miscellaneous losses.

Some of the indicated increase in demand for distillate fuels during the near term months, as here forecast, is expected to result from preuse shipments of these fuels to consumers and distributors. This is considered desirable in order to avoid hampering of refinery operations by lack of storage facilities in the months immediately preceding the heating season. The need for the transfer of stocks from refinery to consumer and distributor storage is indicated by the fact that operators are now encouraging the filling of outside storage capacity by guarantees against losses from price declines.

Residual fuels.—The forecast of demand for residual fuels reflects the current relationship of prices of that product to prices of competing fuels. It is expected that this relationship will result in increasing demands for residual fuels by those consumers who can readily convert from more costly fuels.

In summary, the forecasts presented above anticipate that factors which have resulted in appreciable growth in demands for petroleum products during the postwar years will continue to be effective but that the rate of increase will not be as high as it has been in the past few years.

the MIDYEAR REPORT

Foreign Output Up 460,000 Bbl. Daily, or 15.9 Per Cent

by Dahl M. Duff

ALL foreign areas (excluding Russia and Eastern Europe) showed an increase of some 460,000 bbl. daily, or 15.9 per cent in the first half of 1949 compared to the same period in 1948. Daily average foreign output was 3,379,500 bbl. compared with 2,917,900 bbl. the first half of 1948.

This gain in production is particularly outstanding since it was made in spite of the cutbacks in Venezuela early this year. Much of the over-all increase is attributable to the trend in the Middle East where production rose nearly 40 per cent between the two half-year periods.

Greatest gain made in crude-oil production by any country in the first half of 1949 was that shown in Kuwait, the small shiekhdom at the head of the Persian Gulf where rights are held jointly by Anglo-Iranian Oil Co., Ltd., and Gulf Oil Corp.

Commercial production in Burgan field did not commence until after the war. The rapidly rising output reached 280,900 bbl. daily in April. Kuwait's daily average for the first 6 months of 1949 is placed at 253,300 bbl. daily, an increase of more than 200 per cent over the corresponding period of last year.

Kuwait's production dropped back in May to 258,100 bbl. daily, and there are indications the world-wide reduction in the rate of increase of petroleum demand is affecting the Kuwait production trend.

The tabulation of changes in foreign production from the first half of 1948 to the first half of 1949 also shows that the most marked decline of any country was in Iraq which borders on Kuwait to the north. Iraq's first half output averaged 58,900 bbl. daily against 87,400 bbl. daily the same period in 1948. The percentage drop in Iraq was 32.7.

The reduction in Iraq's output was due to political conditions. Production is limited largely to the capacity of the Iraq Petroleum Co., Ltd., lines to the Mediterranean, and the Jewish-Arab differences resulted in the closing of the line through Palestine in April 1948, thus blocking an outlet which had been carrying some 60,000 bbl. daily. The last half of this year will see an upturn in Iraq production with the completion of the new 16-in. parallel line to the north through Syria.

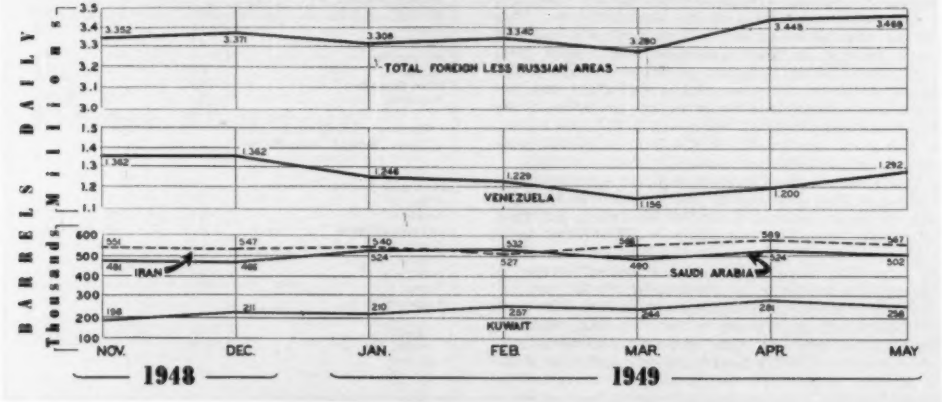
Venezuelan production for the first half of this year was down 5.5 per cent from 1948 to an average of 1,237,100 bbl. daily. The output of this largest single producing country hit 1,383,000 bbl. daily in October 1948 and by March 1949 was down to 1,155,500 bbl. daily. Production the remainder of this year is expected to continue around the present level of approximately 1,300,000 bbl. daily. The decline in Venezuela was caused by oversaturation of the markets for heavy fuel oil, as low-gravity crudes make up about 60 per cent of the country's total potential production.

Western Hemisphere Outside United States

Foreign production in the Western Hemisphere as a whole showed little change. Increases in other areas, notably Canada and Colombia, were sufficient to offset the drop in Venezuela.

Canadian production averaged 53,900 bbl. daily the first half of this year, an increase of 100 per cent over the same period last year. The northern Alberta discoveries beginning with Leduc in Feb-

Foreign Crude-Oil Production



ruary 1947 have now been developed to the point where the local refinery demand has been met, and the last half of this year is expected to see much new production shut in pending completion of the first pipe-line outlet out of the territory, the new Imperial Oil, Ltd., line to Regina.

In Colombia, commercial production of Shell's Dificil field and increases in other areas, especially De Mares, brought about a marked increase in the country's total. For the first half of 1949, the average was 83,500 bbl. daily, up 60 per cent from the same period of 1948. Colombian production in May reached a new high of 87,100 bbl. daily, less natural gasoline and condensate.

Considerable drilling is continuing in Trinidad, and production on this British island has been maintained at about 55,000 bbl. daily. No significant changes have been reported in production in Argentina or Mexico.

In Europe early this year production in the Netherlands' Schoonebeek field was steadied at its apparent economic level of slightly above 11,000 bbl. daily. The joint company of Shell and Standard Oil Co. (N.J.) is continuing exploration elsewhere in the country. There also has been considerable activity in the German oil industry centering particularly in the Emsland area near the Dutch border. Preliminary information indicates German production in June hit a new postwar high of 16,300 bbl. daily against an average of 14,800 bbl. daily the first half of 1949 and 11,400 bbl. daily the first half of 1948.

Development of the new fields of Shell and Socony-Vacuum Oil Co., Inc., in the Suez graben of the Sinai Peninsula resulted in a sharp increase in crude output in Egypt. The 42,400 bbl. daily average for the first half of this year represents an increase of about 27 per cent over the first half of 1948. Clarification of the political and legal outlook for foreign capital in this country is still awaited.

Middle East Considerations

There are two considerations outstanding in connection with the Middle East. The first is that the Persian Gulf producing countries of Saudi Arabia, Iran, and Kuwait all show large increases the first half of this year when compared with the same period of 1948. A large part of this has been necessary to meet the demands in Europe and the requirements under the Economic Cooperation Administration.

The second factor is that the production of these areas appears to be stabilizing, or at least settling down to a more normal rate of growth. No marked changes are anticipated until completion of the first of the several pipe lines to the Mediterranean. This will be the Trans-Arabian Pipe Line Co. project which is to go into limited operation by August 1950.

The production program of these countries has been affected by the slowdown in European requirements and by world-wide currency problems. Arabian American Oil Co. is planning to hold its output for the year to around 500,000 bbl. daily—as indicated by its 508,800-bbl. first-half daily average.

Conditions in the Far East continue unsettled, but in spite of this, Indonesian production was brought back up to an estimated 120,000 bbl. daily the first half of this year. This compares to 176,000 bbl. daily in 1938 and 78,800 bbl. daily the first half of 1948. The operating companies are still denied access to properties in northern Sumatra and parts of Java.

Burma's production, an important factor in prewar petroleum operations in the Far East, remains virtually negligible in view of political disturbances in the country. Shell's associated companies in British Borneo have been outstandingly successful in developing this area, particularly Seria field in Brunei. First half production is estimated at an average of 67,000 bbl. daily, a 34 per cent increase.

While Western Canada holds probably the leading position in wildcatting and development, there is considerable exploratory activity taking place elsewhere in the world, and several recent discoveries may be reflected in production totals during the last half of this year.

A recent discovery by the government-controlled oil company in Italy attracted considerable attention. It remains to be fully evaluated. Good production was shown in tests on a new well in northern Pakistan, and German operators feel a new field will be developed near Ruehlertwist. Western New Guinea went into commercial production last December, and Anglo-Iranian Oil Co., Ltd.-Standard-Vacuum Oil Co. interests are carrying out an exploration program in Papua.

FOREIGN CRUDE-OIL PRODUCTION
(In thousands of barrels daily)

Country—	First 6 mos., 1949*	First 6 mos., 1948	Percentage increase
Western Hemisphere:			
Argentina	63.4	63.7	—0.5
Bolivia	1.9	1.0	90.0
Brazil	0.3	0.3	
Canada	53.9	26.9	100.0
Colombia	83.5	52.3	60.0
Cuba	0.3	0.3	
Ecuador	7.0	7.0	
Mexico	156.8	157.5	—0.4
Peru	39.9	37.0	7.8
Trinidad	55.9	54.9	1.8
Venezuela	1,237.1	1,309.6	—5.5
Total	1,700.0	1,710.5	—0.6
Europe and Africa:			
France	1.1	1.1	
French Morocco	0.4	0.3	33.3
Germany	14.8	11.4	30.0
Italy	0.2	0.2	
Netherlands	11.7	7.6	54.0
Egypt	42.4	33.5	26.6
United Kingdom	0.9	0.9	
Total	71.5	55.0	30.0
Middle East:			
Bahrein	30.2	29.6	2.0
Iran	557.8	481.1	16.0
Iraq	58.9	87.4	—32.6
Kuwait	253.3	82.6	206.7
Saudi Arabia	508.8	331.2	53.6
Total	1,409.0	1,011.9	39.2
Far East:			
British Borneo	67.0	49.9	34.3
Borneo	0.6	0.5	20.0
China	1.8	1.5	20.0
India	5.3	5.3	
Indonesia	115.0	78.8	45.9
Japan	3.5	3.2	9.4
New Guinea	4.5		
Pakistan	1.5	1.3	15.4
Total	199.2	140.5	41.8
Total, foreign less Russia and E. Europe	3,379.7	2,917.9	15.8
Russia and Eastern Europe:			
Albania	1.0	1.0	
Austria	17.5	17.0	2.9
Czechoslovakia	0.9	0.4	125.0
Hungary	10.0	10.0	
Poland	2.7	2.7	
Romania	80.0	78.6	1.8
Russia	620.0	590.0	5.1
Yugoslavia	1.1	1.1	
Total	733.2	700.8	4.6
Total, foreign	4,112.9	3,618.7	13.7

*Partly estimated.

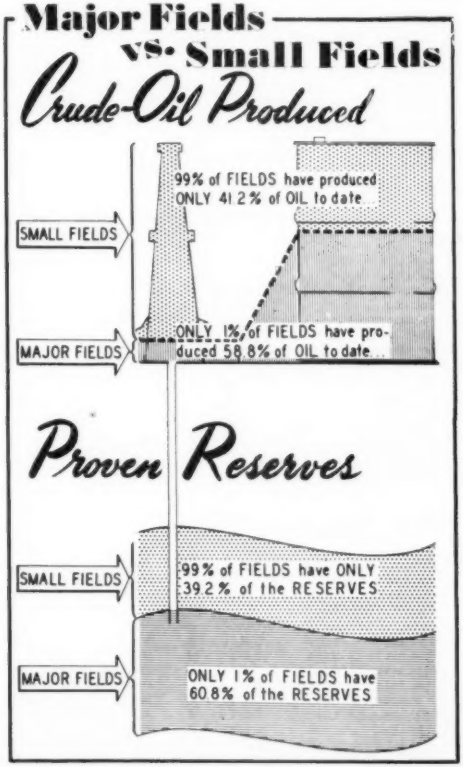
the MIDYEAR REPORT

Major Fields Take Brunt Of Cuts in Production

by Charles J. Deegan

THIS is the seventh report The Oil and Gas Journal has made on major fields. When the first report was made in the midyear review and forecast issue in 1946, it is doubtful if anyone realized how much new light would be thrown on many petroleum industry problems by this compilation. The subsequent reports in each annual review forecast issue in January and each midyear report in July have usually shown some new aspect of the importance of these fields, and the list has grown more complete.

This midyear report, marking the end of the postwar adjustment, and showing a decrease in production for the United States, reveals the importance of the major fields in a period when downward adjustments must be made in production. Table I shows that to achieve a net reduction in the first half of 1949 compared to the first half of 1948, of 27.4 million barrels, the 130 major fields were reduced 44.2 million barrels, while all other fields had a net increase of 16.8 million barrels.


Major Fields
vs. Small Fields
Crude-Oil Produced
99% of FIELDS have produced ONLY 41.2% of OIL to date
SMALL FIELDS
ONLY 1% of FIELDS have produced 58.8% of OIL to date
MAJOR FIELDS
Proven Reserves
SMALL FIELDS
99% of FIELDS have ONLY 39.2% of the RESERVES
MAJOR FIELDS
ONLY 1% of FIELDS have 60.8% of the RESERVES

Apparently it is the handful of major fields that give us most of the flexibility necessary when reductions in production are necessary. By the same evidence, it is apparent that whenever large increases in production are required quickly, unless there is a potential substantial increase available in these relatively few fields, the odds are against securing the necessary increase quickly. Large increases from sources other than major fields will probably require very heavy drilling campaigns.

We are now entering a period when costs are being watched very carefully. Again we find the figures indicate that the major fields weigh very heavily in the scales, probably far out of proportion to their numbers. The detailed data on just how many wells have been drilled in the development of these fields are not available. Nor is the information available on just how many of these were dry.

If these figures were compiled, we could tell how many barrels of oil per well were developed and proven; we could tell how many barrels of oil per well per day are being produced at the present time; how much oil has been produced per well drilled in the past; and how many barrels per well of proven reserves there are remaining.

Exact Comparisons Not Possible Yet

Lacking these figures, exact comparisons cannot be made yet. But it is obvious from the high percentage of both total United States' past production and the high proportion of total United States' proven reserves, that the per well figure on all counts must be much higher in these few major fields than it can possibly be in all the other fields.

Therefore the cost of each well can be spread over a substantially larger number of barrels of oil. That means that the investment cost per barrel must have been substantially smaller than in all other fields. Since both past and current production represents such a high percentage of the total United States, it also probably means that as a group, the current operating cost per barrel is substantially lower in these fields than in the others.

Both lower investment cost per barrel and lower operating cost per barrel work in the same direction —to higher profit per barrel at any given price of oil. Since no individual operator has any control over price, but within limits can do something about his investment and operating costs, this is important. In any analysis of an individual operator's costs, he will probably find it advisable to segregate his properties in these major fields from his other properties. There will be exceptions, of course. But the larger the operator, and the more widespread his operations, the more it is likely to be advisable to do this.

Since the net profit per barrel is likely to be much larger in a major field than in other fields,

TABLE 1—ANALYSIS OF PRODUCTION CHANGES FIRST HALF 1949 VS. FIRST HALF 1948
(Thousands of barrels)

	Production		
	First half 1949	First half 1948	Change
Texas:			
51 major fields	230,933	269,934	—39,001
All other fields	180,391	174,940	+ 5,451
California:			
29 major fields	120,683	124,000	— 3,317
All other fields	50,240	48,957	+ 1,283
Louisiana:			
9 major fields	19,176	18,959	+ 217
All other fields	81,559	73,079	+ 8,480
Oklahoma:			
18 major fields	27,092	29,381	— 2,289
All other fields	48,286	45,700	+ 2,586
Kansas:			
3 major fields	8,565	9,025	— 460
All other fields	42,973	43,722	— 749
Illinois:			
4 major fields	6,780	7,270	— 440
All other fields	24,773	23,782	+ 991
New Mexico:			
4 major fields	10,838	9,893	+ 945
All other fields	15,285	13,312	+ 1,973
Wyoming:			
4 major fields	7,914	9,348	— 1,434
All other fields	15,051	17,084	— 2,033
Mississippi:			
3 major fields	7,626	8,808	— 1,182
All other fields	12,566	14,116	— 1,550
Arkansas:			
2 major fields	4,137	4,198	— 61
All other fields	11,083	11,791	— 708
Colorado:			
1 major field	9,924	6,294	+ 3,630
All other fields	1,725	1,924	— 199
All other states:			
2 major fields	6,770	7,518	— 748
All other fields	26,383	25,122	+ 1,261
Total United States:			
130 major fields	460,438	504,628	—44,190
All other fields	510,315	493,529	+ 16,786

fluctuations in allowables in these fields is quite apt to exert a leverage factor on total profits. A 5 or 10 per cent increase in allowables is likely to result in a much larger net profit in these fields than in others. Of course the reverse is also true: a 5 or 10 per cent reduction in allowables is apt to result in greater reduction in net profits than the small reduction in allowable would indicate.

In view of all these important effects on costs and profits, it is not surprising that there is an increasing interest in studying the whys and wherefores of major fields. Some of the work is partially public (*See The Oil and Gas Journal, May 19, 1949, page 190—"Gulf Coast Oil—Why Are These Fields Where They Are?"*). Some work, judging from indirect indications, is being carried on by individual companies, the lines of attack and results remaining company secrets.

One line of attack might be to study what changes would occur in the figures if the size of the fields included was lowered slightly. The present list stops at 100 million barrels ultimate production

TABLE 2—PRODUCTION DATA—FIRST HALF 1949
(Thousands of barrels)

State—	No. major fields	Production— All fields	Major fields	Per cent by major fields
Texas	51	411,324	230,933	56.3
California	29	170,923	120,683	70.5
Louisiana	9	100,735	19,176	19.1
Oklahoma	18	75,378	27,092	36.1
Kansas	3	51,538	8,565	16.7
Illinois	4	31,553	6,780	21.5
New Mexico	4	26,123	10,838	41.7
Wyoming	4	22,965	7,914	34.5
Mississippi	3	20,192	7,626	37.8
Arkansas	2	15,220	4,137	27.2
Colorado	1	11,649	9,924	85.2
All others	2	33,153	6,770	20.4
Total United States	130	970,753	460,438	47.4

as a minimum. Among the leading producing states, Louisiana, Kansas, Illinois, and Arkansas do not seem to have as high a percentage of such large fields in their total as Texas, California, and Oklahoma. What would be the effect in these states of including fields as low as 75 million barrels ultimate?

Offhand it seems possible that dropping the minimum down to 75 or maybe 50 million barrels ultimate, might bring the percentage of southern Louisiana's total from major fields up consideraly. Suppose it did. Why? Does it mean that some conditions in Middle and Upper Miocene acted as limiting factors on the growth of major accumulations of oil, stopping their buildup at a lesser figure than in the older Tertiary fields across the line in Texas?

Why are Kansas and Illinois characterized by so many smaller fields, and so few majors? How about North Texas? What about the often-noted pattern of fields being found in clusters or groups in a given geological area, but one of the fields will be of major size, the others much smaller. Is this always due to the size of the trap available? Why does the Devonian carry oil over such a widespread area in North America, and produce a fairly substantial number of major accumulations?

TABLE 3—RESERVES MAJOR FIELDS VS. STATES TOTAL RESERVES
(Millions of barrels)

	Proven reserves 1-1-49	Major fields reserves 7-1-49	Per cent by major fields	No. of major fields
Texas	14,094	9,996	70.9	51
California	3,581	2,485	69.4	29
Louisiana	2,050	464	22.6	9
Oklahoma	1,116	511	45.8	18
Wyoming	745	387	51.9	4
Kansas	652	149	22.9	3
New Mexico	576	277	48.1	4
Mississippi	495	218	44.0	3
Illinois	402	141	35.1	4
Colorado	315	263	83.5	1
Arkansas	300	107	35.7	2
Pennsylvania-New York	158	110	69.6	2
All others	350	0	0	0
Total United States	24,834	15,108	60.8	130

Major Fields vs. Total United States Reserves and Production*

(In thousands of barrels)

State and field—	Year of first discovery	1-1-49 est. ultimate prod.	Remaining reserves 7-1-49	Cumulative prod. to 7-1-49	Prod. first half 1949	Prod. first half 1948	Main sand (S) or lime (L)	Geologic age of main production
CALIFORNIA:								
Buena Vista	1909	450,000	78,599	371,401	7,387	8,358	S	Plio.
Coalinga, East	1900	330,000	60,979	269,021	3,365	3,374	S	Plio.-Mio.
Coalinga, Nose	1938	370,000	226,056	143,944	8,949	9,598	S	Eocene
Coalinga, West	1900	190,000	25,476	164,524	1,086	1,263	S	Plio.-Mio.
Coles Levee, North	1938	115,000	68,957	46,003	3,065	2,959	S	Mio.
Elk Hills	1919	475,000	274,329	200,671	1,453	1,176	S	Plio.-Mio.
Kern Front	1925	105,000	34,880	70,120	1,390	1,668	S	Plio.
Kern River	1899	350,000	45,635	304,365	2,028	2,207	S	Plio.
Kettleman North Dome	1928	455,000	98,846	356,154	5,946	6,478	S	Mio.-Eocene

MAJOR FIELDS* VS. TOTAL UNITED STATES RESERVES AND PRODUCTION (Continued)

(In thousands of barrels)

State and field—	Year of first discovery	1-1-49 est. ultimate prod.	Remaining reserves 7-1-49	Cumulative prod. to 7-1-49	Prod. first half 1949	Prod. first half 1948	Main sand (S) or lime (L)	Geologic age of main production
McKittrick-Cymric	1887	185,000	68,758	116,242	3,617	3,939	S	Plio.-Eocene
Midway-Sunset	1901	850,000	107,156	742,844	6,818	7,725	S	Plio.-Mio.
Mount Poso	1926	155,000	66,955	88,045	2,124	2,369	S	Mio.
Rio Bravo	1937	100,000	50,521	49,479	2,138	2,214	S	Mio.
Elwood	1927	110,000	25,623	84,377	1,369	1,345	S	Plio.-Mio.
Orcutt	1903	125,000	16,772	108,228	830	780	S	Mio.
Santa Maria Valley	1934	185,000	90,286	94,714	3,195	5,194	S	Mio.
Ventura Avenue	1916	540,000	174,372	365,628	9,974	8,410	S	Plio.
Brea Olinda	1888	245,000	44,233	200,767	2,753	2,115	S	Plio.-Mio.
Coyote, West	1909	210,000	47,455	162,545	2,507	2,745	S	Plio.
Dominguez	1923	245,000	64,512	180,488	2,375	2,752	S	Plio.-Mio.
Huntington Beach	1920	590,000	162,018	427,982	10,829	8,929	S	Plio.-Mio.
Inglewood	1924	210,000	42,635	167,365	2,472	2,203	S	Plio.-Mio.
Long Beach	1921	825,000	86,202	738,798	4,114	4,308	S	Plio.-Mio.
Montebello	1917	175,000	22,829	152,171	1,185	1,389	S	Plio.-Mio.
Richfield	1919	130,000	19,238	110,762	1,143	1,212	S	Plio.
Santa Fe Springs	1919	580,000	54,473	525,527	2,641	2,985	S	Plio.-Mio.
Seal Beach	1926	155,000	38,953	116,047	2,189	2,046	S	Plio.-Mio.
Torrance	1922	155,000	28,226	126,774	1,389	1,509	S	Mio.
Wilmington	1935	800,000	360,423	439,577	22,352	22,762	S	Plio.-Mio.
Subtotal		9,410,000	2,485,437	6,924,563	120,683	124,000		
ROCKY MOUNTAIN AREA:								
Elk Basin (Wyo. and Mont.)	1915	290,000	244,328	45,672	3,962	3,180	S	Pa.
Lance Creek	1918	105,000	22,653	82,347	1,439	1,815	S	Jur.-Pa.
Oregon Basin	1927	100,000	53,229	46,771	562	2,035	S-L	Cret.-Pa.
Rangely	1902	310,000	262,963	47,037	9,924	6,294	S	U. Cret.-Pa.
Salt Creek	1908	400,000	66,481	333,519	1,951	2,318	S	Cret.-Jur.-Pa.
Subtotal		1,205,000	649,654	555,346	17,838	15,642		
OKLAHOMA:								
Avant	1904	108,000	8,731	99,269	283	310	S	Pa.
Bowlegs	1926	150,000	20,275	129,725	590	629	S	Pa.-Sil.-Dev.-Ord.
Burbank	1920	250,000	22,873	227,127	1,140	1,191	S	Pa.
Cement	1917	100,000	46,129	53,871	2,049	2,286	S	Perm.-Pa.
Cushing	1912	420,000	38,953	381,047	1,386	1,395	S-L	Pa.-Ord.
Earlsboro	1924	138,000	6,545	131,455	278	279	S	Pa.-Sil.-Dev.-Ord.
Edmond, West	1943	150,000	64,345	85,655	3,169	5,548	L	Sil.-Dev.-Hunton
Flits	1933	115,000	8,331	106,669	542	581	S	Pa.-Sil.-Dev.-Ord.
Glenn Pool	1905	260,000	22,778	237,222	1,274	1,285	S	Pa.-Ord.
Healdton	1913	245,000	35,288	209,712	1,284	1,239	S	Pa.-Ord.
Hewitt and West	1919	125,000	16,933	108,067	984	829	S	Pa.-Ord.
Little River	1927	140,000	17,575	122,425	610	742	S	Pa.-Ord.
Oklahoma City	1928	725,000	60,439	664,561	3,807	4,365	S	Pa.-Ord.-Wilcox
Seminole City	1926	150,000	10,182	139,818	535	553	S	Pa.-Sil.-Dev.-Ord.
Sholem Alechem	1923	100,000	49,564	50,436	3,105	1,484	S	Pa.
St. Louis	1927	190,000	17,798	172,202	646	650	S	Pa.-Sil.-Dev.-Ord.
Tonkawa	1921	127,000	2,523	124,477	132	161	S	Pa.-Ord.-Wilcox
Velma	1917	100,000	63,805	36,195	5,278	5,854	S-L	Pa.-Ord.
Subtotal		3,591,000	511,067	3,079,933	27,092	29,391		
KANSAS:								
El Dorado	1916	250,000	49,878	200,122	1,500	1,398	L	Pa.-Ord.
Silica	1931	115,000	29,371	85,629	2,450	2,463	L	Pa.-Ord.
Trapp	1939	180,000	69,691	110,309	4,615	5,164	L	Pa.-Ord.
Subtotal		545,000	148,940	396,060	8,565	9,025		
ARKANSAS:								
Magnolia	1938	110,000	52,638	57,362	2,245	2,279	S-L	Jurassic
Smackover	1922	475,000	54,198	420,802	1,892	1,919	S	Jur.-U. Cret.
Subtotal		585,000	106,836	478,164	4,137	4,198		
LOUISIANA:								
Caddo	1905	205,000	23,801	181,199	2,061	1,422	S	U. and L. Cret.
Delhi-Big Creek	1944	175,000	142,057	32,943	4,870	5,166	S	U. Cret.
Erath	1940	125,000	91,286	33,714	2,966	3,037	S	Ter.-Mio.
Haynesville	1921	125,000	24,525	100,475	2,280	1,961	S-L	U. and L. Cret.
Iowa	1931	100,000	34,004	65,996	1,210	1,215	S	Ter.-Mio.
Jennings	1901	115,000	14,613	100,387	592	826	S	Ter.-Mio.
Lafitte	1935	120,000	61,222	58,778	2,011	2,082	S	Ter.-Mio.
Rodessa (Tex.-La.-Ark.)	1930	185,000	24,931	160,069	1,360	1,498	L	Cret.
Vinton	1910	110,000	47,847	62,153	1,826	1,752	S	Ter.-Mio.
Subtotal		1,260,000	464,286	795,714	19,176	18,959		
MISSISSIPPI:								
Cranfield	1943	110,000	88,048	21,952	3,420	3,168	S	Cret.
Heidelberg	1944	100,000	79,913	20,087	1,371	2,548	S	Cret.
Tinsley	1939	160,000	50,141	109,859	2,835	3,092	S	Cret.
Subtotal		370,000	218,102	151,898	7,626	8,808		
ILLINOIS:								
Bridgeport	1906	265,000	23,630	241,370	930	968	S	Pa.
Louden	1937	210,000	63,343	146,657	3,080	3,391	S-L	Miss.-Dev.
Robinson	1906	170,000	13,714	156,286	668	598	S	Pa.
Salem	1938	250,000	39,838	210,162	2,102	2,313	S-L	Miss.-Dev.
Subtotal		895,000	140,525	754,475	6,780	7,270		

MAJOR FIELDS* VS. TOTAL UNITED STATES RESERVES AND PRODUCTION (Continued)

(In thousands of barrels)

State and field—	Year of first discovery	1-1-49 est. ultimate prod.	Remaining reserves 7-1-49	Cumulative prod. to 7-1-49	Prod. first half 1949	Prod. first half 1948	Main sand (S) or lime (L)	Geologic age of main production
NEW MEXICO:								
Eunice	1928	150,000	56,365	93,635	2,396	2,370	L	Perm.
Hobbs	1928	175,000	49,404	125,596	1,993	1,890	L	Perm.
Monument	1934	185,000	87,442	97,558	3,701	3,425	L	Perm.
Vacuum	1929	130,000	83,572	46,428	2,748	2,208	L	Perm.
Subtotal		640,000	276,783	363,217	10,838	9,893		
EASTERN TEXAS:								
East Texas field	1930	5,000,000	2,360,687	2,639,313	52,098	56,328	S	U. Cret.-Woodbine
Hawkins	1940	500,000	397,119	102,881	6,485	8,787	S	U. Cret.-Woodbine
Mexia	1912	107,000	5,505	101,495	189	212	S	U. Cret.-Woodbine
Powell	1923	123,000	4,312	118,688	178	186	S	U. Cret.-Woodbine
Talco	1936	220,000	106,018	113,982	3,335	4,348	L	L. Cret.-Paluxy
Van	1929	450,000	249,812	200,188	4,724	5,722	S	U. Cret.-Woodbine
Subtotal		6,400,000	3,123,453	3,276,547	68,009	75,583		
NORTH TEXAS:								
Burkburnett	1912	185,000	19,213	165,787	780	703	S	Pa.
K.M.A.	1931	180,000	54,447	125,553	2,624	2,565	S-L	Pa.-Strawn
Electra	1911	200,000	40,065	159,935	1,286	1,480	S	Pa.
Subtotal		565,000	113,725	451,275	4,690	4,748		
SOUTHWEST TEXAS:								
Luling-Branyon	1921	110,000	18,313	91,687	706	760	L	L. Cret.-Edwards
Darst Creek	1928	105,000	32,951	72,049	1,266	1,259	L	L. Cret.-Edwards
Subtotal		215,000	51,264	163,736	1,972	2,019		
WEST TEXAS:								
Big Lake	1923	125,000	15,541	109,459	546	553	L	Perm.-Ord.
Cowden, North	1930	225,000	146,254	78,746	3,265	4,713	L	Perm.
Foster	1932	145,000	90,593	54,407	3,247	4,114	L	Perm.
Fullerton	1942	400,000	343,544	56,456	5,723	8,538	L	Perm.-Dev.-Ord.
Goldsmith	1934	400,000	301,669	98,331	5,123	5,242	L	Perm.
Hendricks	1926	230,000	15,838	214,162	661	610	L	Perm.
Howard-Glasscock	1926	210,000	73,083	136,917	2,436	2,587	L	Perm.
Keystone	1930	420,000	348,508	71,492	5,891	6,897	L	Perm.-Ord.
Levelland	1945	100,000	84,977	15,023	4,496	2,908	L	Perm.
McCamey	1925	125,000	49,207	75,793	1,429	1,715	L	Perm.
McElroy	1926	335,000	144,859	190,141	4,597	5,136	L	Perm.
Seminole	1937	200,000	148,909	51,091	3,016	4,014	L	Perm.
Slaughter	1936	500,000	362,759	137,241	7,460	9,275	L	Perm.
T-X-L	1944	250,000	193,720	56,280	9,360	11,740	L	Perm.-Sil.-Dev.-Ord.
Ward, North, and Estes	1929	120,000	53,934	66,066	1,640	1,991	L	Perm.
Wasson	1936	650,000	460,790	189,210	10,925	14,378	L	Perm.
Yates	1926	800,000	443,680	356,320	8,446	8,940	L	Perm.
Subtotal		5,235,000	3,277,865	1,957,135	72,261	93,351		
PANHANDLE TEXAS:								
Badger	1926	105,000	39,519	65,481	1,817	1,790	L	Perm.
Borger-Pantex	1926	135,000	27,445	107,555	1,863	1,446	L	Perm.
Finley	1926	130,000	46,200	83,800	2,206	2,312	GW	Pa.
West Pampa	1926	130,000	39,599	90,401	2,527	2,350	L	Perm.
Subtotal		500,000	152,763	347,237	8,213	7,898		
TEXAS GULF COAST:								
Agua Dulce to La Gloria	1928	1,350,000	1,167,242	182,758	14,648	15,054	S	Ter.-Olig.
Anahuac	1935	250,000	158,896	91,104	3,932	5,363	S	Ter.-Olig.
Barbers Hill	1916	115,000	26,775	88,225	959	1,006	S	Ter.-Olig.-Mio.
Conroe	1931	550,000	273,990	276,010	6,406	10,967	S	Ter.-Eoc.
Greta	1933	115,000	64,367	50,633	1,655	1,921	S	Ter.-Olig.-Mio.
Hastings	1934	450,000	273,151	176,849	7,943	10,538	S	Ter.-Olig.
Hull	1918	125,000	19,116	105,884	826	670	S	Ter.-E.O.M.
Humble and Light	1904	145,000	11,616	133,384	676	410	S	Ter.-E.O.M.
Katy	1938	120,000	93,646	26,354	2,795	2,469	S	Ter.-Eoc.
Magnet-Withers and North	1936	115,000	61,105	53,895	2,025	2,824	S	Ter.-Olig.
Old Ocean	1934	170,000	115,714	54,286	3,599	2,229	S	Ter.-Olig.
Refugio area	1931	100,000	41,311	58,689	1,262	1,651	S	Ter.-Olig.
Sour Lake	1902	100,000	14,521	85,479	573	569	S	Ter.-E.O.M.
Spindletop	1901	135,000	5,830	129,170	254	178	S	Ter.-Olig.-Mio.
Thompson	1931	325,000	187,773	137,227	6,242	6,151	S	Ter.-Olig.-Mio.
Tom O'Connor	1934	500,000	359,007	140,993	6,708	9,131	S	Ter.-Olig.
Webster (Friendswood)	1937	380,000	247,181	132,819	7,181	10,509	S	Ter.-Eoc.-Olig.
West Columbia	1902	135,000	27,890	107,110	1,278	1,254	S	Ter.-Olig.-Mio.
West Ranch	1938	185,000	127,859	57,141	2,828	3,441	S	Ter.-Olig.
Subtotal		5,365,000	3,276,930	2,088,010	71,788	86,335		
NEW YORK-PENNSYLVANIA:								
Allegany	1879	170,000	39,994	130,006	1,724	1,737	S	Devonian
Bradford	1871	591,000	70,003	520,997	5,046	5,781	S	Devonian
Subtotal		761,000	109,997	651,003	6,770	7,518		
Total major fields		37,542,000	15,107,587	22,434,313	460,438	504,628		
Total U. S. all fields to date		63,017,441	24,834,008	38,183,441	970,753	998,157		
Major field's share of total		59.6%	60.8%	58.8%	47.4%	50.6%		

*Fields with estimated ultimate production of 100 million barrels or more. †U. S. total as of January 1, 1949.

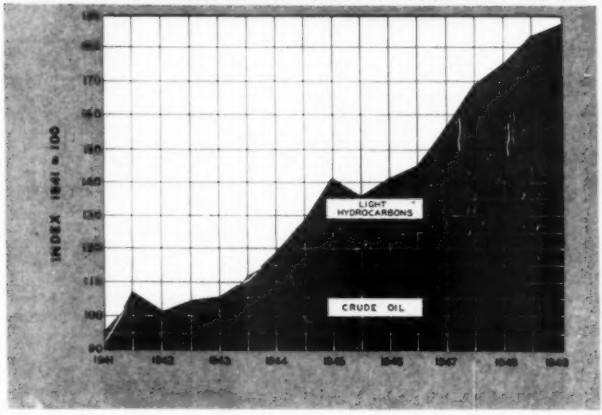
the MIDYEAR REPORT
Statistical Section

Light-Hydrocarbon Production Up 7 Per Cent First 4 Months

PLANT production of light hydrocarbons in the first 4 months of this year increased 7.0 per cent over the same months last year compared with a 2.5 per cent drop in crude production. The January-April average for natural-gasoline and cycling plants was 17,557,000 gal. daily. With a slight drop estimated for the past 2 months, the average for the first half of the year was about 17,400,000 gal. per day, an increase of 6.7 per cent over the first half of 1948. Crude production for the first half was added to storage this year than during last year.

This rapid stock buildup during the winter had a decided effect on the natural-gasoline market. Group 3 price for 26-70 natural gasoline remained at 8.5 cents per gallon throughout 1948, but four successive drops brought it down to 5.0 cents by the middle of last March. Since that time, two 0.25 cent increases raised the price level to 5.5 cents at midyear. This sets a 10-year record for differential between prices of natural and regular grade.

CRUDE OIL AND LIGHT HYDROCARBON PRODUCTION INDEXES



PRODUCTION AT NATURAL-GASOLINE AND CYCLING PLANTS JANUARY-APRIL
(Thousands of gallons daily)

	1949	1948	Increase	Per cent increase
Appalachian	498	498		
N. Central	597	611	— 15	— 2.5
Kansas	296	304	— 8	— 2.6
Oklahoma	1,365	1,264	+ 101	+ 8.0
Texas	8,509	7,838	+ 671	+ 8.6
Arkansas	275	264	+ 11	+ 4.2
Louisiana	2,109	1,830	+ 279	+15.2
Mississippi	135	125	+ 10	+ 8.0
New Mexico	405	306	+ 99	+32.4
Rocky Mtn.	190	210	— 20	— 9.5
California	3,178	3,163	+ 15	+ 0.5
Total U. S.	17,557	16,413	+1,144	+ 7.0

NATURAL-GASOLINE AND CYCLING PLANT OUTPUT BY PRODUCTS

	Jan.-Apr. 1949	Jan.-Apr. 1948	Increase	Per cent increase
Nat. gasoline	7,851	7,604	+ 247	3.2
Raw condensate	1,116	1,018	+ 98	9.6
L.P.G.	6,676	6,156	+ 512	8.4
Other	1,914	1,635	+ 279	17.1
Total	17,557	16,413	+1,144	7.0

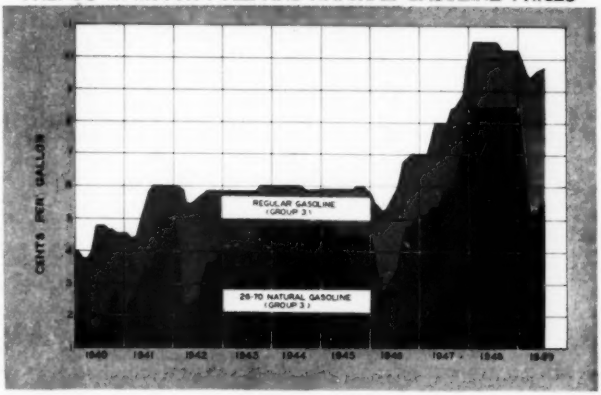
down about 5 per cent.

Texas with 48.5 per cent of light-product production in the first 4 months, accounted for 58.7 per cent of the total gain over the previous year. New Mexico had the largest relative increase with production up 32.4 per cent over the same months in 1948.

Not all of the gain in production was needed to meet increased consumption of light products. The indicated demand for plant-produced natural-gas liquids in the January-April period was 5.7 per cent above a year ago with the remainder of the production gain going into increased stock accumulation.

Stocks increased at the rate of 586,000 gal. daily in the first 4 months of this year compared with 351,000 gal. per day last year. Thus, about 67 per cent more light products were

TRENDS IN MOTOR-FUEL AND NATURAL-GASOLINE PRICES



the MIDYEAR REPORT
Statistical Section

Refiners Shift Product Yields To Conform to Market Changes

by John C. Casper

RESPONDING to changes in petroleum-product demand, refiners have made decided shifts in refinery yields since last year. Total gasoline demand in the first 4 months of this year was about 7 per cent greater than in the same months last year. During April 1948, refiners averaged 16.88 gal. of gasoline from a barrel of crude but by April of this year the yield was increased to 18.52 gal. per barrel for a gain of 9.7 per cent.

Middle-distillate demand was below normal last winter because of warm weather in the areas where consumption for home heating is usually high. Yields of both kerosine and distillate fuels were reduced to meet the changed conditions but at the end of the first quarter stocks of these two products were 50 per cent greater than a year earlier. Production of middle distillate in February of this year averaged 10.21 gal. per barrel of crude compared with 11.55 gal. for February 1948, a reduction of 11.6 per cent.

Excess residual-fuel production continues to be one of the big problems for refiners but some progress has been made. Yields in recent months have been down to about 22 per cent of the total output from a barrel of crude.

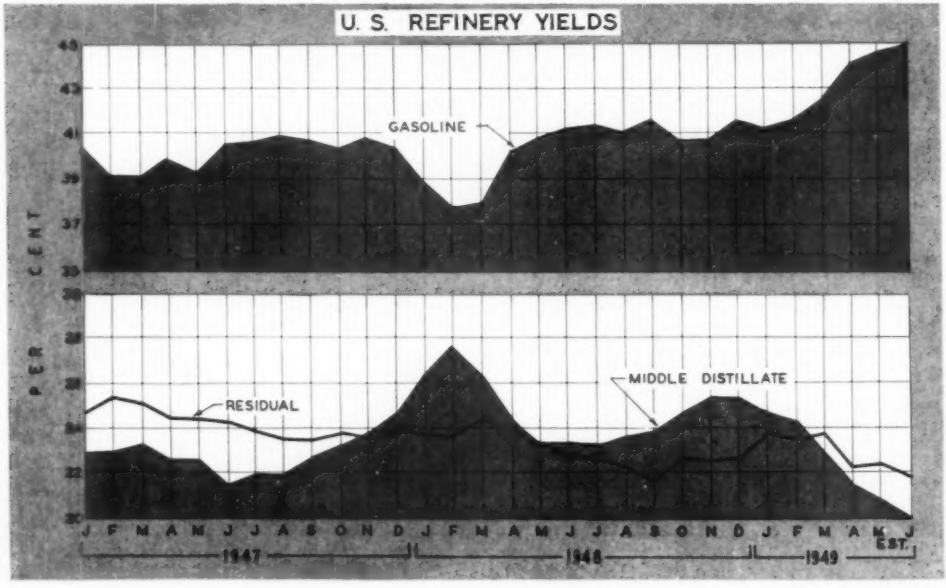
Production of lubricating oils in April amounted to 0.92 gal. per barrel of crude processed compared with 1.09 gal. during the first 5 months of 1948. On a yield basis, this represents a decrease of about 15.6 per cent.

REFINERY YIELDS OF GASOLINE (BY DISTRICTS)

	April 1947	April 1948	April 1949
East Coast	32.9	35.9	39.8
Appalachian	42.6	43.5	47.1
Illinois-Indiana	44.6	46.7	51.1
Oklahoma-Kansas	45.2	45.3	47.5
Texas Inland	48.9	47.9	47.7
Texas Gulf	40.2	39.9	46.8
Louisiana Gulf	41.2	39.7	47.8
N. Louisiana-Arkansas	31.9	30.5	35.2
Rocky Mountain	43.5	42.4	41.7
California	34.4	33.9	33.0
Total U. S.	39.8	40.2	44.1

REFINERY YIELDS OF MIDDLE DISTILLATE (BY DISTRICTS)

	April 1947	April 1948	April 1949
East Coast	25.6	24.4	22.2
Appalachian	19.0	20.3	16.2
Illinois-Indiana	23.2	22.3	20.8
Oklahoma-Kansas	23.6	25.1	24.7
Texas Inland	14.2	16.1	14.9
Texas Gulf	25.7	28.9	23.7
Louisiana Gulf	29.3	31.5	32.0
N. Louisiana-Arkansas	24.3	27.2	25.1
Rocky Mountain	20.2	19.8	22.3
California	15.2	17.9	14.8
Total U. S.	22.6	24.1	21.5


U. S. REFINERY YIELDS
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the MIDYEAR REPORT
Statistical Section

Utility Sales of Natural Gas Up 8.6 Per Cent Over 1948

by Henry D. Ralph

CONSUMPTION of natural gas continues to increase, and during the first half of this year utility sales were 8.6 per cent greater than during the like period of 1948, reaching a record total of 1,620,000,000 M.c.f.

During the past 6 months the number of utility customers for natural gas increased 8.4 per cent, and the natural-gas revenues of utility companies increased 10.5 per cent.

This increase continues a steady trend in gas consumption which has been evident since the end of the war, as shown by the accompanying chart which gives sales by half-year periods in millions of cubic feet per day. Sales were converted to a daily basis for the purposes of comparison and presented by half years to emphasize the seasonal nature of the business, since much of the utility gas is used for space heating.

This tremendous increase in business is attributed to the convenience of natural gas as a fuel for many purposes and also to its low price in comparison with other fuels. The wholesale-price index of the Bureau of Labor Statistics, which uses 1926 prices as 100, carried gas in April with an index of 92.8, whereas run-of-mine bituminous coal had a price index of 192.1.

The demand was met by a huge construction program which is still continuing, indicating that increases in sales of similar magnitude can be expected for the next several years. On page 208 of this issue is a table showing the natural-gas transmission lines completed during the first half of this year, the projects now under construction, and those planned for the near future. A survey just completed by the American Gas Association shows that the gas industry has budgeted $3,539,000,000 for new construction during the 5-year period 1948-52, with the bulk of it for natural gas and more than half of the total for transmission lines. *(The Oil and Gas Journal, July 21, page 40.)*

The figures for utility sales used on this page are those of the American Gas Association (with sales for June 1949 estimated by The Oil and Gas Journal), and include only sales of public utility companies classifed as sellers of natural gas. They do not include natural gas used by companies classified as selling mixed gas, nor natural gas or liquefied petroleum gas used in enriching manufactured gas.

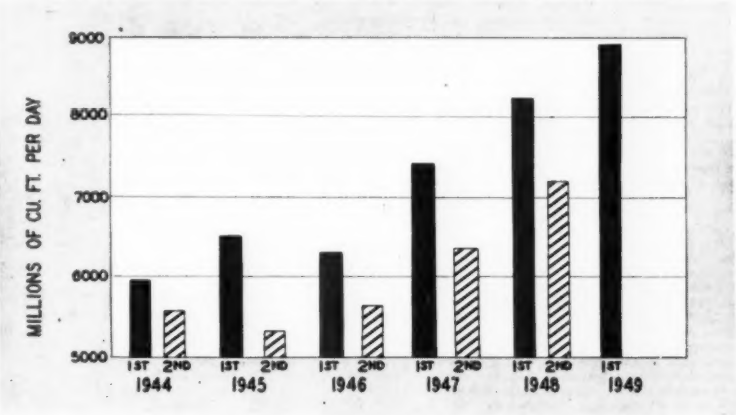
Moreover, utility sales represent little more than half of all the natural gas marketed, as they do not include gas used locally, by carbon black and chemical plants, or by oil and gas companies in their producing, refining, and transmission operations. Surveys made by the U. S. Bureau of Mines show that in 1947, for example, the total marketed production of natural gas in the United States (not including that used for oil-field repressuring operations) was 4,444,693, M.M.c.f., whereas utility sales during 1947 were only 2,515,251 M.M.c.f., or 56 per cent of the total. Before the war, utility sales averaged between 52 and 55 per cent of total sales of natural gas, indicating that the trend is toward the utilization of a greater percentage through public-utility transmission lines.

NATURAL GAS SALES BY UTILITIES FIRST HALF OF YEAR

	1949*	1948	Per cent change
Customers†	12,070,300	11,133,900	+ 8.4
Sales in M.c.f.	1,621,364,200	1,493,498,600	+ 8.6
Revenues	$603,000,000	$545,871,300	+ 10.5

*Five months from American Gas Association, one month The Oil and Gas Journal estimate. †Average of first two quarters.

NATURAL GAS SALES BY UTILITIES···(HALF YEAR PERIODS)



the MIDYEAR REPORT

More Than 150 Active Refinery Building Projects Now Under Way

by R. B. Tuttle

REPORTS direct from operators in the refining industry show that more than 45 new expansion projects are yet to be started at the beginning of this year's second-half period. Twenty-three of these projects carry approvals for early completion. Despite 80 completed projects during the first 6 months of this year, the over-all expansion program involves more than 150 active building projects at the year's mid period.

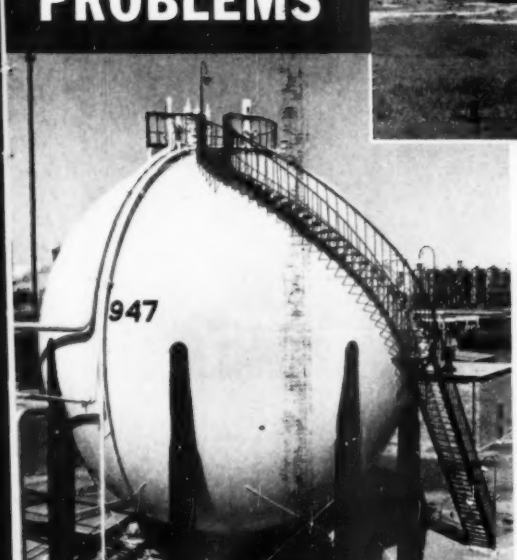
In the field of petrochemical manufacture nine new plant projects are now under way. Currently active also are a number of projects for the expansion of recently completed facilities. Three projects covering petrochemical plant enlargement are scheduled to start during the last 6 months of the year. These projects have been authorized and are expected to be under way soon.

Building activity in the natural-gas processing industry is strong. Under serious consideration are 10 projects involving approximately 150 million cubic feet of daily gas capacity. Two of these projects, pending final approval, are new plants. The others cover expansion of existing installations. In the group of authorized projects are 18 different jobs involving both new plants and additions to existing installations. Number of completed projects to year's mid period exceeds 75.

ACTIVE REFINERY BUILDING PROJECTS

Company, location and type of project	Capacity rating	Status	Comp. schedule	Contractors
Aurora Gasoline Co., Detroit:				
Vis-breaker, bbl. per day	5,000	Building	Sept. '49	Aurora Gasoline Co.
Cat. poly unit, bbl. per day	600	Building	Aug. '49	Aurora Gasoline Co.
Bareco Oil Co., Barnsdall, Okla.:				
Propane deasphalting unit, bbl. per day	600	Considering		
Byerlyte Corp., Cleveland, Ohio:				
Install oxidizers (2), bbl. per day	1,000	Considering		
Berry Asphalt Co., Stephens, Ark.:				
Refinery expansion		Planned		
British-American Oil Co., Ltd., Montreal:				
Catalytic cracking unit, bbl. per day	13,500	Building	Sept. '49	The M. W. Kellogg Co.
Cat. polymerization unit, bbl. per day	500	Building	Late '49	The M. W. Kellogg Co.-Koch Engineering Co., Inc.
Crude distillation unit, bbl. per day	14,500	Building	Sept. '49	The M. W. Kellogg Co.
California Refining Co., Perth Amboy, N. J.:				
Rebuild asphalt plant, bbl. per day	1,200	Authorized	Apr. '50	
Carter Oil Co., Billings, Mont.:				
Catalytic cracking unit, bbl. per day	10,000	Building	Aug. '49	Fluor Corp.-Universal Oil Products Co.
Carthage Hydrocol, Inc., Brownville, Tex.:				
Hydrocarbon synthesis plant, cu. ft. per day	100,000,000	Building	Late '49	Arthur G. McKee & Co.
Champlin Refining Co., Enid, Okla.:				
Crude pipe still, bbl. per day	18,000	Building	Oct. '49	Koch Engineering Co.
Polymerization unit, bbl. per day	400	Building	Oct. '49	Koch Engineering Co.
Citcon Corp., Lake Charles, La.:				
Lube-oil plant, bbl. per day	6,000	Building	Mid '49	The Lummus Co.-Max B. Miller
Cities Service Oil Co. (Del.), Cicero, Ill.:				
Compounding plant, bbl. per day	1,200	Building	Early '50	Sumner S. Sollitt Co.
Continental Oil Co., Billings, Mont.:				
New refinery, bbl. per day (includes cat. cracking, poly and desulfurization)	7,500	Building	Oct. '49	Jones & Laughlin Supply Co.
Continental Oil Co., Ponca City, Okla.:				
Crude-oil pipe still, bbl. per day	19,000	Building	Oct. '49	Bechtel Corp.
Cooperative Refinery Association, Coffeyville, Kans.:				
Dewaxing unit, bbl. per day	2,200	Building	Sept. '49	Process Engineers, Inc.
Revamp cat. unit, bbl. per day	5,500	Building	July '49	
Cosden Petroleum Corp., Big Springs, Tex.:				
Catalytic cracking, bbl. per day	7,500	Building	Oct. '49	Universal Oil Products Co., Refinery Engineering Co.
Deep Rock Oil Corp., Cushing, Okla.:				
Cat. cracking unit, bbl. per day	5,000	Building	Early '50	Jones & Laughlin Supply Co. and Universal Oil Products Co.
Crude-oil distillation unit		Authorized		
Derby Oil Co., Wichita:				
Cat. cracking and plant changes		Considering		
Dow Chemical Co. of Canada, Sarnia, Ont.:				
Petrochemical plant additions		Building	Late '49	
El Dorado Refining Co., El Dorado, Kans.:				
Cat. cracking unit		Considering		
Empire Petroleum Co., Denver:				
Crude-oil distillation unit, bbl. per day	3,000	Planned		
Additional storage, bbl.	100,000	Planned		
Asphalt storage warehouse		Planned		
Empire State Oil Co., Thermopolis, Wyo.:				
Crude-oil topping unit, bbl. per day	5,000	Building	July '49	Refinery Engineering Co.

3 WAYS to solve PRESSURE STORAGE PROBLEMS



1. With HORTONSPHEROIDS

These efficient pressure storage tanks prevent excessive evaporation losses from petroleum hydrocarbons ranging in volatility from motor gasoline to natural gasoline. They are available in capacities from 2,000 to 120,000 bbls. with working pressures from 2½ to 100 lbs. per sq. in. (higher pressures in the smaller sizes only).

2. With HORTONSPHERES

Hortonspheres provide the most efficient, most economical means of high-pressure storage of the more volatile grades of natural gasoline, butanes, butane-propane mixtures and volatile refinery stocks. Standard sizes include units up to 65 ft. in diameter for gases or 25,000-bbl. capacity for liquids, with pressure ranges from 30 to 150 lbs. per sq. in.

3. With HEMISPHEROIDS

For capacities from 2,000 to 30,000 bbls. for 2½ lbs. per sq. in. and 2,000 to 7,500 for 5 lbs. per sq. in. pressure, these tanks combine the advantages of spheroidal design with the low erection cost of a cylindrical shell. They are built with plain or noded roofs and bottoms depending upon size and pressure required.

The distinguishing feature of these three types of Horton tanks is their ability to store volatile petroleum products without loss by withstanding internal pressures developed under storage conditions. So long as this internal pressure does not exceed the setting of the relief valve, no vapors will escape and there will be no evaporation loss. All three—Hortonspheroid, Hortonsphere, or Hemispheroid—are designed to do an efficient job in reducing evaporation losses from specific types of volatile products. When selecting pressure storage facilities, contact our nearest office for information regarding the type of Horton tank best suited to meet your requirements.

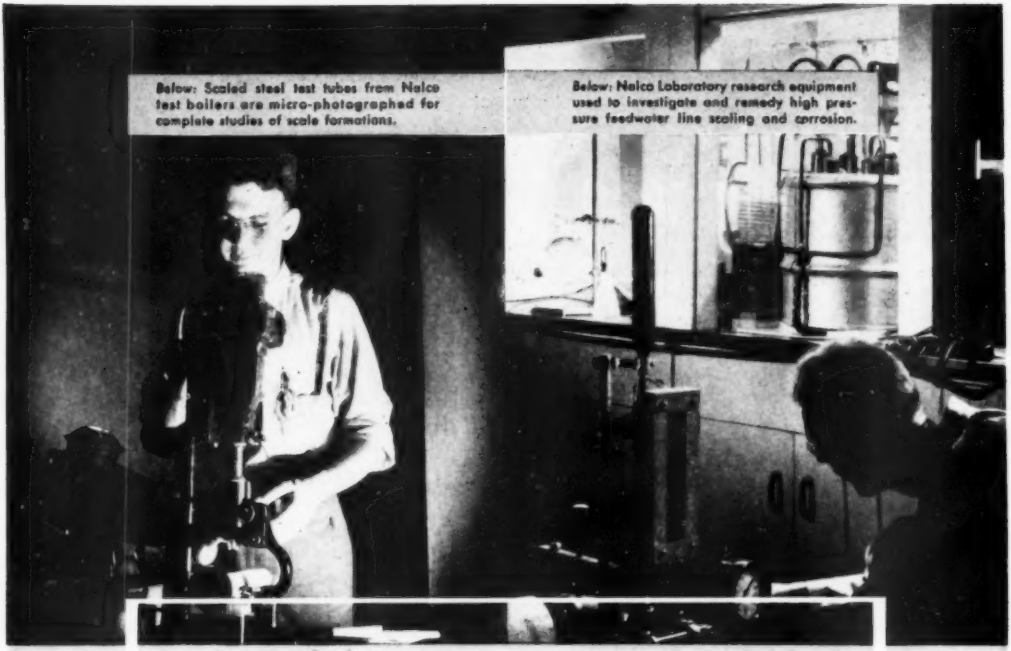
CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Atlanta, 3.....2154 Healey Bldg.
Birmingham, 1.....1536 North 50th St.
Boston, 10.....1025—201 Devonshire St.
Chicago, 4.....2128 McCormick Bldg.
Cleveland, 15.....2204 Guildhall Bldg.
Detroit, 26.....1514 Lafayette Bldg.
Havana.....402 Abreu Bldg.
Houston, 2.....2119 National Standard Bldg.
Los Angeles, 14....1523 General Petroleum Bldg.
New York, 6.....3347—165 Broadway Bldg.
Philadelphia, 3...1615—1700 Walnut Street Bldg.
Salt Lake City, 1..1525 First Security Bank Bldg.
San Francisco, 11..1254—22 Battery Street Bldg.
Seattle, 1.....1325 Henry Bldg.
Tulsa, 3.....1606 Hunt Bldg.

REPRESENTATIVES AND LICENSEES

Horton Steel Works, Limited, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Compagnia Tecnica Industrie Petroli, S.A.I., Rome, Italy
Whessoe, Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Chicago Bridge & Iron Company, Ltd., Apartado 1348, Caracas, Venezuela



Below: Scaled steel test tubes from Nalco test boilers are micro-photographed for complete studies of scale formations.

Below: Nalco Laboratory research equipment used to investigate and remedy high pressure feedwater line scaling and corrosion.

Nalco SELLS WATER TREATMENT

RESULTS

Engineers who visit Nalco nearly always become Nalco System users if they are not already. Nalco personnel, equipment and facilities are illustrated and briefly described in the full-color book *This is Nalco* to show you why this is true. Your copy will be sent upon request.

NOT too many years ago, it was frequently more difficult to sell a program of water treatment results than to sell so-called cure-all boiler compounds. Today, Nalco's perseverance in selling results—and in producing continuously *better* results through basic research and development—has played a large part in bringing all water treatment chemistry to its present high standard.

In your plant, the Nalco System not only assures smooth-running, effective water treatment; but also provides expert assistance that helps lighten the important burden of water treatment responsibility.

Your Nalco Representative is available promptly to start the Nalco System in your plant. Call him today—or write direct for complete information.

NATIONAL ALUMINATE CORPORATION
6242 W. 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario, Canada

THE

SYSTEM...Serving Industry Through Practical Applied Science

ACTIVE REFINERY BUILDING PROJECTS (Continued)

Company, location and type of project—	Capacity rating	Status	Comp. schedule	Contractors
Esso Standard Oil Co., Baton Rouge:				
New mechanical shops		Building	Sept. '49	C. F. Braun Co.
New main office and cafeteria		Building	Mid '50	John W. Harris Associates, Inc., and Bodman & Murrell
Crude desalting, bbl. per day	18,000	Authorized	1949	.....
Esso Standard Oil Co., Bayonne, N. J.:				
Dewaxing unit, bbl. per day	7,500	Building	Early '50	E. B. Badger & Sons Co.
Esso Standard Oil Co., Linden, N. J.:				
Catalytic cracking unit, bbl. per day	41,000	Building	Late '49	C. F. Braun Co.
Excelsior Refineries, Lloydminster, Alta.:				
Capacity increase, bbl. per day	1,500	Building	1950	.....
Floz-on Manufacturing Co., Houston:				
Petrochemical plant		Building	.....	.....
Freeport Sulfur Co., Westville, N. J.:				
Sulfur recovery plant, tons per day	40	Authorized	.....	Girdler Corp.
General Petroleum Corp., Torrance, Calif.:				
Revamp crude unit, bbl. per day	32,000	Building	Early '49	C. F. Braun Co.
Expand cat. cracker furnace, bbl. per day	4,000	Building	Early '49	The Lummus Co.
Globe Oil & Refining Co., Lemont, Ill.:				
Cat. cracking unit, bbl. per day	6,000	Building	Dec. '49	Universal Oil Products Co. and Globe O. & R. Co.
Great Lakes Refining Division, Petco Corp., Blue Island, Ill.:				
Cat. cracking unit, bbl. per day	5,000	Building	Late '49	Catalytic Construction Co. and Petco Corp.
Gulf Oil Corp., Philadelphia:				
Topping and vacuum unit, bbl. per day	30,000	Building	Sept. '49	The Lummus Co.
Gulf Refining Co., Cincinnati:				
Catalytic cracking unit, bbl. per day	15,000	Building	Sept. '49	The M. W. Kellogg Co.
Polymerization unit, bbl. per day	5,000	Building	Sept. '49	The M. W. Kellogg Co.
Gulf Refining Co., Toledo:				
Catalytic cracking unit, bbl. per day	15,500	Building	Aug. '49	The M. W. Kellogg Co.
Polymerization unit, bbl. per day	5,000	Building	Aug. '49	The M. W. Kellogg Co.
Gulf Oil Corp., Port Arthur, Tex.:				
Modernize cat. cracking unit		Building	Late '49	Catalytic Construction Co.
Hancock Chemical Co., Watson, Calif.:				
Sulfur-recovery plant addition, tons per day	50	Authorized	Dec. '49	E. B. Badger & Sons Co.
Hercules Powder Co., Hercules, Calif.:				
Ammonia plant		Building	1949	Bechtel Corp.
Hi-Way Refineries, Saskatoon, Canada:				
Thermal cracking unit, bbl. per day	600	Building	Dec. '49	Universal Oil Products Co. and Refinery Engineering Co.
Crude-oil unit, bbl. per day	2,040	Building	Dec. '49	Universal Oil Products Co. and Refinery Engineering Co.
Humble Oil & Refining Co., Baytown, Tex.:				
Increase crude distillation capacity, bbl. per day	18,000	Building	Late '49	Foster Wheeler Corp.
Husky Refining Co., Lloydminster, Canada:				
Increase refinery capacity, bbl. per day	5,000	Building	Mid '49	.....
Hutex Oil & Refining Co., Hardin, Tex.:				
Skimming unit, bbl. per day	1,000	Considering	Mid '49	.....
Fractionators for solvents		Considering	Mid '49	.....
Imperial Oil, Ltd., Regina, Sask.:				
Additional distillation equipment, bbl. per day	3,000	Building	Early '50	.....
Imperial Oil, Ltd., Edmonton, Alta.:				
Crude-oil still, bbl. per day	9,000	Building	Aug. '49	.....
Lion Oil Co., El Dorado, Ark.:				
Increase petrochemical plant		Building	Late '49	Chemical Construction Corp., Blaw-Knox
Magnolia Petroleum Co., Beaumont, Tex.:				
Cat. cracking units		Authorized	Late '50	.....
McColl-Frontenac Oil Co., Ltd., Edmonton, Alta., Canada:				
New refinery		Considering	.....	.....
MFA Oil Co. (Refinery Div.), Chanute, Kans.:				
Desulfurization facilities, bbl. per day	1,000	Building	Sept. '49	Koch Engineering Co.
Mohawk Petroleum Corp., Bakersfield, Calif.:				
Topping and feed preparation unit, bbl. per day	7,500	Authorized	1949	.....
Monarch Refineries, Inc., Oklahoma City:				
Vacuum lube unit		Planned	.....	.....
North Star Oil, Ltd., St. Boniface, Man.:				
Reforming unit, bbl. per day	850	Building	1949	.....
North Star Refining Co., Shelby, Mont.:				
Moving refinery		Planned	.....	.....
Northwestern Refining Co., St. Paul Park, Minn.:				
Loading rack, gal. per day	500,000	Building	Jan. '50	.....
Products transfer line		Building	Jan. '50	.....
Ohio Oil Co., The, Robinson, Ill.:				
Catalytic cracking unit, bbl. per day	12,400	Building	Mid '49	Universal Oil Products Co.-Arthur G. McKee & Co.
Atmospheric and vacuum unit, bbl. per day	27,500	Building	Mid '49	Universal Oil Products Co.-Arthur G. McKee & Co.
Catalytic poly. unit, bbl. per day	3,800	Building	Mid '49	Universal Oil Products Co.-Arthur G. McKee & Co.
Increase steam-generating plant, lb. per hr.	240,000	Building	Mid '49	Arthur G. McKee & Co.
Increase electric-generating plant, kw.	10,000	Building	Mid '49	Arthur G. McKee & Co.
Gasoline-treating plant		Building	Mid '49	Universal Oil Products Co. and Arthur G. McKee & Co.
Old Dutch Refining Co., Muskegon, Mich.:				
Platforming unit, bbl. per day	2,000	Building	.....	.....

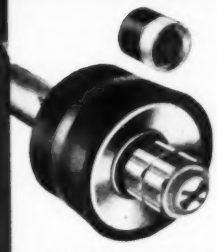
ACTIVE REFINERY BUILDING PROJECTS (Continued)

Company, location and type of project—	Capacity rating	Status	Comp. schedule	Contractors
Pana Refining Co., Pana, Ill.:				
Revise thermal cracking unit, bbl. per day	1,800	Authorized	Mid '49	Universal Oil Products Co. and Refinery Engineering Co.
Panhandle Producing & Refining Co., Wichita Falls, Tex.:				
Catalytic cracking unit, bbl. per day	1,500	Building	Early '50	Universal Oil Products Co.-Jones & Laughlin Supply Co.
Panther Oil & Grease Co., Leaside, Ont.:				
Plant revisions		Building	Aug. '49	
Phillips Chemical Co., Etter, Tex.:				
Petrochemical plant capacity increase to, tons per year	100,000	Authorized		
Phillips Oil Co., Kansas City, Kans.:				
Catalytic cracking unit, bbl. per day	24,000	Building	Late '49	C. F. Braun Co.
Catalytic polymerization unit, bbl. per day	1,500	Building	Late '49	C. F. Braun Co.
Producers Refinery, Inc., West Branch, Mich.:				
Refinery expansion, bbl. per day	1,500	Planned	1949	
Pure Oil Co., Savannah, Ga.:				
Lube-oil processing plant		Authorized		
Quaker State Oil Refining Corp., Emlenton, Pa.:				
Addition to boiler plant, lb. per hr.	65,000	Building	Nov. '49	
Rock Island Refining Corp., Rock Island, Ind.:				
Catalytic cracking unit, bbl. per day	5,000	Building	Aug. '49	Universal Oil Products Co.-Rock Island Staff
Root Petroleum Co., El Dorado, Ark.:				
Delayed coking unit		Considering		
Salt Lake Refining Co., Salt Lake City:				
Cat. cracking unit		Authorized	1950	
Shallow Water Refining Co., Shallow Water, Kans.:				
Cat. reforming unit, bbl. per day	1,000	Building	Mar. '50	Koch Engineering Co.
Addition to thermal cracking units, bbl. per day	600	Building	Dec. '49	Koch Engineering Co.
Shell Chemical Co., Pittsburg, Calif.:				
Ammonia plant		Building	Mid '49	Bechtel Corp.
Shell Oil Co., Inc., Wilmington and Martinez, Calif.:				
Extend tank storage		Building	Late '49	Chicago Bridge & Iron Co.
Extend cracking-plant compressors		Building	Late '49	Fluor Corp.
Shell Oil Co. of Canada, Ltd., Montreal:				
Polymerization unit, bbl. per day	3,300	Building	Early '50	Fluor Corp.
Cat. cracking unit		Building		
Vacuum unit		Building		
Gasoline-treating unit		Building		
Skelly Oil Co., El Dorado, Kans.:				
Modernize refinery, bbl. per day	35,000	Building	Mid '50	The M. W. Kellogg Co.
Socony-Vacuum Oil Co., Trenton, Mich.:				
Cat. cracking unit		Authorized	Late '50	
Socony-Vacuum Oil Co., Augusta, Kans.:				
Cat. cracking unit		Authorized	Late '50	
Socony-Vacuum Oil Co., Inc., Casper, Wyo.:				
Revision to topping units		Building	Late '49	Catalytic Construction Co.
Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.:				
Crude-oil distillation unit, bbl. per day	19,500	Building	Mid '49	E. B. Badger & Sons Co.
Propane deasphalting unit, bbl. per day	5,950	Building	Mid '49	E. B. Badger & Sons Co.
Dewaxing unit, bbl. per day	2,050	Building	Mid '49	E. B. Badger & Sons Co.
Gasoline-treating unit, bbl. per day	25,000	Building	Dec. '49	E. B. Badger & Sons Co.
Kerosine-treating unit, bbl. per day	3,600	Building	Dec. '49	E. B. Badger & Sons Co.
Socony-Vacuum Oil Co., Inc., East St. Louis, Ill.:				
Increase crude-oil distillation capacity, bbl. per day	15,000	Building	Aug. '49	Bechtel Corp.
Thermal cracking unit, bbl. per day	13,200	Building	Dec. '49	Bechtel Corp.
Delayed-coking unit, bbl. per day	8,000	Authorized	Mar. '50	Bechtel Corp.
Standard Oil Co. of California, Bakersfield, Calif.:				
Catalytic cracking unit, bbl. per day	10,000	Building	Late '49	
Alteration to crude unit, bbl. per day	20,000	Building	Late '49	
Standard Oil Co. (Ind.), Casper, Wyo.:				
Catalytic cracking unit, bbl. per day	8,000	Building	1949	The M. W. Kellogg Co.
Standard Oil Co. (Ohio), Lima:				
Catalytic cracking unit, bbl. per day	16,000	Building	Late '49	Arthur G. McKee & Co.
Combination crude-coking unit, bbl. per day	15,000	Authorized	Early '50	The M. W. Kellogg Co.
Lube-oil solvent-refining unit, gal. per day	76,000	Authorized	1051	The M. W. Kellogg Co.-The Lummus Co.
Solvent extraction unit, bbl. per day product	1,800	Authorized	1951	The Lummus Co.-The M. W. Kellogg Co.
Vacuum unit, bbl. per day	9,000	Authorized	Mid '50	The Lummus Co.-The M. W. Kellogg Co.
Propane deasphalting unit, bbl. per day	800	Authorized	Mid '50	The M. W. Kellogg Co.
Stanolind Oil & Gas Co., Brownsville, Tex.:				
Chemicals recovery and refining, lb. per year	100,000,000	Authorized	Early '50	E. B. Badger & Sons Co.
Sun Oil Co., Toledo:				
Catalytic cracking and topping units, bbl. per day each	30,000	Building	Late '49	Catalytic Construction Co.
Crude-oil desalting unit, bbl. per day	20,000	Authorized		
Gas concentration unit, cu. ft. per day	40,000,000	Building	Dec. '49	Catalytic Construction Co. and Process Engineers, Inc.
Compressor station, 4 units, hp.	3,840	Building		Fluor Corp.
Sun Oil Co., Marcus Hook, Pa.:				
Wax-refining plant		Building	July '49	Sun Oil Co.
Packaging plant		Building	Oct. '49	W. W. Lindsay Co.
Sunset Oil Co., Los Angeles:				
Additional topping facilities, bbl. per day	4,000	Authorized	Mid '49	
Talco Asphalt & Refining Division, American Liberty Oil Co., Mount Pleasant, Tex.:				
Asphalt-loading and storage facilities		Building	July '49	
Texas Co., Westville, N. J.:				
New refinery, bbl. per day	40,000	Building	Mid '49	Foster Wheeler Corp., The M. W. Kellogg Co., Jackson-Moreland

Mission REPLACEABLE RUBBERS

... speed operations!

... save money!



MISSION Piston Mounted on MISSION Super-Surfaced Rod, and MISSION Gland Packing.

THE MISSION PISTON with ***replaceable rubbers*** has introduced important savings in drilling operations.

First of all, it saves ***operating time!*** The overall durability of the piston is unequalled, resulting in fewest possible shutdowns. When a replacement is necessary, only the rubbers are changed, without removing the piston from the rod. This is a far easier, quicker operation than changing the complete piston.

Second, it saves ***upkeep*** costs! Replacing the rubbers on the piston body provides the equivalent of a new piston, for MISSION piston bodies will wear out several sets of replacement rubbers.

You should obtain the full details about the advantages of this piston.

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MISSION Slush Pump Valve

MISSION MANUFACTURING CO.

Wilson SPUDDER OWNERS ARE Wilson BOOSTERS

B. W. HALEY
DRILLING CONTRACTOR
ARCADE BUILDING
TELEPHONE 183 P. O. BOX 188
CARMI, ILLINOIS

June 1, 1949

Wilson Manufacturing Company, Inc.,
P. O. Box 599,
Wichita Falls, Texas.

Gentlemen:

On February 28, 1949, I purchased from your firm, through the Boyaird Supply Company, two of your Mogul Rocker Arm Type Spudders for use in the Illinois Basin.

Upon their arrival in Illinois, early in March, they were immediately set up, and have been operating constantly since then. They have given complete satisfaction, and I have had no repair bills on the machines of any sort.

For drilling, drilling-in, and cleanout work I have found them to be the finest machines available, and am pleased to recommend them to you for such operations.

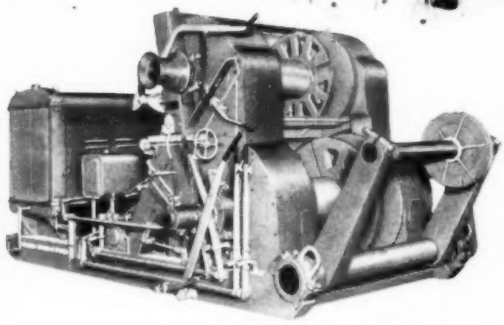
Yours very truly,
B. W. Haley
B. W. Haley

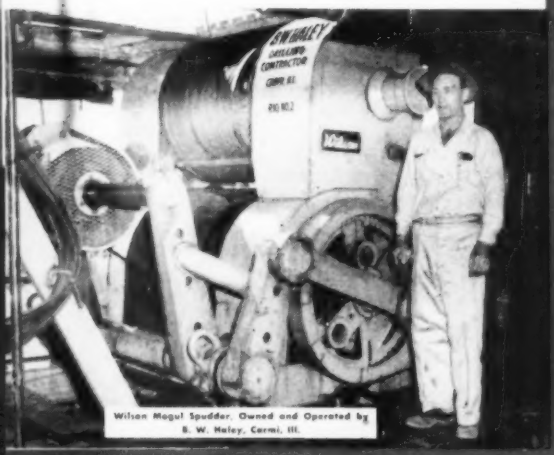
BWH:TB

WILSON MOGUL ROCKER ARM SPUDDERS . . . have given complete satisfaction . . . no repair bills . . . of any sort.

writes Contractor B. W. HALEY of CARMI, ILLINOIS

In the drilling industry, it's PERFORMANCE that counts! Wilson owners agree that the Wilson Mogul Model Spudder is the finest machine made for drilling, drilling-in, and cleanout work. Wilson is indebted to Mr. Haley for the very fine letter telling of his success with a Wilson Mogul Model Spudder. We will be happy to show you, too, how your drilling operations can be made simpler . . . more ECONOMICAL . . . more PROFITABLE . . . with a WILSON Mogul Rocker Arm Type Spudder.





Wilson Mogul Spudder, Owned and Operated by B. W. Haley, Carmi, Ill.

SOME REASONS WHY B. W. HALEY CHOSE THIS MOGUL MODEL SPUDDER

WILSON Rocker Action does a better job! A highly satisfactory spudding motion, plus great strength, ruggedness and simplicity of construction has been achieved. This motion is so smooth, easy and well designed that no springs or other devices are needed to correct it. Designed to produce a quick, free drop of the tools, with a slow, easy lift that reduces jerk . . . this spudder will hit a harder blow that increases the speed of drilling.

SPECIFICATIONS: Manual Controls . . . Heavy Duty Rocking Arm Spudder . . . Spudder Sheave Guard . . . Box Section Frame . . . Oil Bath Guards, Engine to Countershaft . . . 2 Speed Jackshaft Assembly in Oil Bath Housing . . . Streamlined Guards on Rig Front . . . Spudder Strokes 31"—38"—46". LOWER DRUM: 8 Speeds to Drum . . . Friction Clutch in Drum End . . . Drum Divider . . . Friction Latch on Brake Lever. UPPER DRUM: 4" Drum Shaft Extended with Plain Cathead on Each End . . . 8 Speeds to Drum . . . Friction Clutch in Drum End . . . Drum Divider.

Wilson
MANUFACTURING CO., INC.
WICHITA FALLS, TEXAS

ACTIVE REFINERY BUILDING PROJECTS (Continued)

Company, location and type of project—	Capacity rating	Status	Comp. schedule	Contractors
Texas Co., West Tulsa, Okla.:				
Cat. cracking unit		Building		Foster Wheeler Corp.
Crude distillation unit		Building		The M. W. Kellogg Co.
Furfural treating unit		Building		Universal Oil Products Co.
Polymerization unit		Building		
Power-plant addition		Building		
Texas Co., Port Arthur, Tex.:				
Expand lube facilities, bbl. per day	2,500	Building	Mid '49	Foster Wheeler Corp.
Texas Co., Lawrence, Ill.:				
Expand refinery, bbl. per day (added capacity)	20,000	Authorized	Early '51	Foster Wheeler Corp. and The M. W. Kellogg Co.
Tide Water Associated Oil Co., Drumright, Okla.:				
Catalytic cracking unit	5,000	Building	Late '49	Process Engineers, Inc.
Tide Water Associated Oil Co., Bayonne, N. J.:				
Crude unit, bbl. per day	22,500	Building	Early '49	J. F. Pritchard & Co.
Propane deasphalting unit, bbl. per day	3,400	Building	Early '49	J. F. Pritchard & Co.
Solvent extraction unit, bbl. per day	8,750	Building	Early '49	J. F. Pritchard & Co.
Trans-Marine Oil & Refining Co., South Milwaukee, Wis.:				
New refinery, bbl. per day	5,000	Planned		
Trinidad Leaseholds (Canada), Ltd., Port Credit, Canada:				
Treating plant		Planned		
Troy Refining Co., Inc., Troy, Ind.:				
Moving refinery, bbl. per day	1,800	Considering		
Union Oil Co. of California, Oleum, Calif.:				
Plant revisions		Building	1949	Refinery Maintenance Co., Inc., Ralph H. Parsons Co.
Grease-plant improvements		Building	1949	J. M. Montgomery & Co.
Lube-dewaxing plant revisions, bbl. per day	1,900	Building	1949	The M. W. Kellogg Co.
Solvent extraction unit, bbl. per day	6,000	Building	1949	Max B. Miller & Co.
Asphalt loading facilities		Building	1949	Early Construction Co.
United Refining Co., Warren, Pa.:				
New laboratory		Planned		
Increase steam-generating capacity		Planned		
Western States Refining Co., North Salt Lake City, Utah:				
Catalytic cracking unit, bbl. per day	1,500	Considering		
Wood River Oil & Refining Co., Wood River, Ill.:				
Catalytic cracking unit, bbl. per day	7,500	Building	Late '49	
Vacuum unit		Building	Aug. '49	Koch Engineering Co.

NATURAL-GAS PROCESSING PLANT PROJECTS

Anzac Oil Corp., North Coleman County, Texas:				
Gas-injection unit, cu. ft. per day	500,000	Considering	1950	
Atlantic Refining Co., Goldsmith, Tex.:				
Gas-desulfurization unit, cu. ft. per day	20,000,000	Building	July '49	Graff Engineering Co.
Atlantic Refining Co., Crane County, Texas:				
Pressure-maintenance plant, cu. ft. per day	8,000,000	Building	Mid '49	Hudson Engineering Co.
Baldridge & King, San Pablo, Tex.:				
Pressure-maintenance plant, cu. ft. per day	2,500,000	Authorized	Late '49	O. L. Olsen
Barnsdall Oil Co., Placedo, Tex.:				
Compressor station, hp.	1,400	Building	July '49	O. L. Olsen
Bolin Trust, Wichita County, Texas:				
Gas-injection plant		Authorized		
Brazos River Gas Co., Palo Pinto County, Texas:				
Gasoline plant, gal. per day	15,000	Building	1949	Robert L. Purvin and Richard Henry
California Co., The, Barataria, La.:				
Gasoline plant, cu. ft. per day	25,000,000	Considering		
Carter Oil Co., McKamie, Ark.:				
Pressure maintenance, cu. ft. per day	38,000,000	Building	Mid '49	Jones & Laughlin Supply Co.
Chicago Corp., Carthage, Tex.:				
Plant increase to, cu. ft. per day	210,000,000	Building	Mid '49	Fish Engineering Corp.
Cities Service Oil Co., Wise County, Texas:				
Gasoline plant, cu. ft. per day	22,000,000	Building	Late '49	Fluor Corp.
Cities Service Oil Co., Pampa, Tex.:				
Gasoline plant, cu. ft. per day	18,000,000	Building	July '49	Walco Engineering & Const. Co., L. S. Gregory Co.
Continental Oil Co., Ventura, Calif.:				
Revision to gasoline plant, cu. ft. per day	20,000,000	Considering		
Continental Oil Co., Starr County, Texas:				
Plant addition, cu. ft. per day	20,000,000	Building	Early '50	Jones & Laughlin Supply Co.
Continental Oil Co., Big Lake, Tex.:				
Gasoline plant, cu. ft. per day	10,000,000	Building	Sept. '49	Refinery Maintenance Co.
Coronado Gas Corp., Loco Hills field, California:				
Repressuring and extraction plant, cu. ft. per day	10,000,000	Building	Sept. '49	Petroleum Engineering Co., Fred L. Jacobs
Delhi Oil Corp., Barker Dome, N. M.:				
Gas-desulfurization unit, cu. ft. per day	110,000,000	Authorized		Graff Engineering Co.
El Paso Natural Gas Co., Upton County, Texas:				
Gasoline plant, cu. ft. per day	15,000,000	Authorized	Apr. '50	El Paso Natural Gas Co.
El Paso Natural Gas Co., Ward County, Texas:				
Purification plant, cu. ft. per day	15,000,000	Building	Nov. '49	El Paso Natural Gas Co.
El Paso Natural Gas Co., Monahans field, Texas:				
Gasoline plant, cu. ft. per day	15,000,000	Building	Nov. '49	Fluor Corp.
Treating plant		Building	1949	
El Paso Natural Gas Co., McCamey, Tex.:				
Compressors and gas-purification unit, cu. ft. per day	15,000,000	Authorized	Apr. '50	
Gulf Oil Corp., Drinkard, N. M.:				
Gasoline plant, cu. ft. per day	35,000,000	Building	Mid '49	Hudson Engineering Co.

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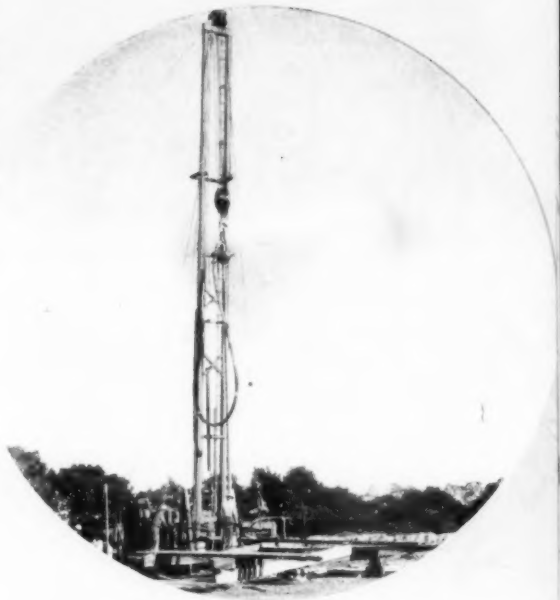
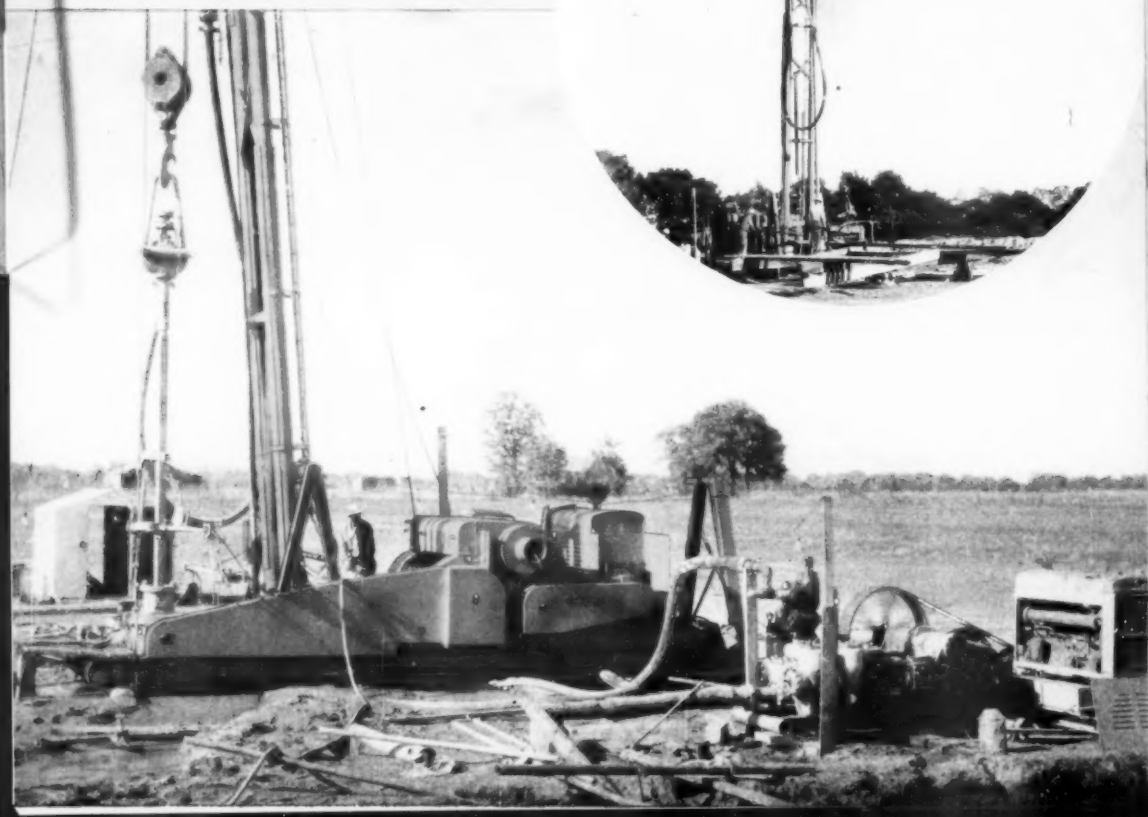
This complete "Cardwell" rig licks the problem of high cost drilling. Low initial cost and high performance, coupled with minimum moving and rig-up expense will enable you to hold your drilling and workover costs to "rock bottom."

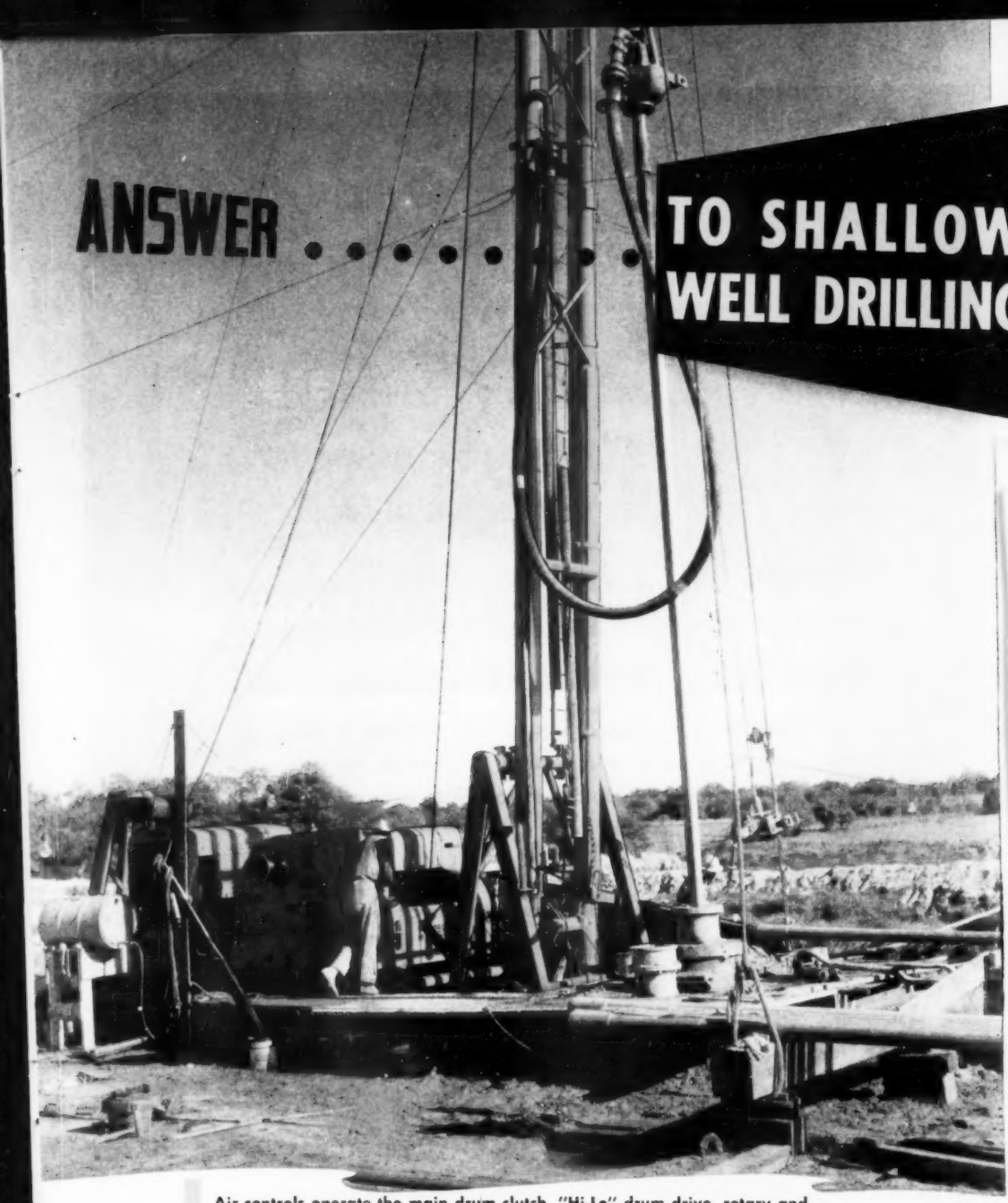
The Model L draw works is completely equipped with "Cardwell" Air Disc friction clutches for maximum speed and ease of operation. Sand line drum is available.

Model L draw works, 65-foot telescoping mast and rotary table are carried on a subframe and the entire unit is easily transported on one truck.





ANSWER . . . . . TO SHALLOW WELL DRILLING



Air controls operate the main drum clutch, "Hi-Lo" drum drive, rotary and automatic cathead clutches. Model L is available with either gear transmission or torque converter, and is recommended for drilling to 3,500 feet with 4½-inch drill pipe, or workover jobs to 7,000 feet. Write for our new bulletin.

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"Cardwell's" reputation in all fields for building "Tough Iron" comes from the use of alloy steels and heat-treatment. This "know how" cannot be copied.

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OF SEISMIC PROSPECTING EXPERIENCE GAINED IN WORLD WIDE OPERATIONS

Only in an integrated organization as large as SSC can the experience necessary to produce accurate Final Maps and Reports be brought to bear on your exploration projects.

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Seismograph Service Corporation

TULSA, OKLAHOMA, U. S. A.

NATURAL-GAS PROCESSING PLANT PROJECTS (Continued)

Company, location and type of project	Capacity rating	Status	Comp. schedule	Contractors
Gulf Oil Corp., Crane County, Texas:				
Gasoline plant, cu. ft. per day	40,000,000	Building		C. F. Braun Co.
Humble Oil & Refining Co., Pickton field, Texas:				
Gasoline plant, cu. ft. per day	18,000,000	Building	1949	Fluor Corp.
Humble Oil & Refining Co., Opelousas, La.:				
Gasoline plant, cu. ft. per day	110,000,000	Building	Mid '49	Hudson Engineering Co.
Humble Oil & Refining Co., Flour Bluff field, Texas:				
Residue gas compression plant, cu. ft. per day	12,000,000	Authorized	Mid '49	
Humble Oil & Refining Co., Bloomington, Tex.:				
Gas-compression plant, cu. ft. per day	22,000,000	Authorized	1949	
Humble Oil & Refining Co., Jourdanton, Tex.:				
Natural-gas processing plant, cu. ft. per day	30,000,000	Building	Mar. '50	Hudson Engineering Corp.
Imperial Oil, Ltd., Leduc field, Canada:				
Gasoline and pressure-maintenance, cu. ft. per day	24,000,000	Building	1950	
Kansas Power & Light Co., Kingman, Kans.:				
Increase compressor capacity, hp	1,100	Building		Dresser Engineering Co.
Kirk Pool Operator's Committee, Eastland County, Texas:				
Gasoline plant		Planned		
La Gloria Corp., Jim Wells County, Texas:				
Casing-head gas-processing facilities, cu. ft. per day	30,000,000	Building	Dec. '49	Hudson Engineering Co.
Lone Star Gas Co., Eastland County, Texas:				
Increase L.P.G. production of, gal. per day	15,000	Considering		
Lone Star Gas Co., Palo Pinto County, Texas:				
Hypersorption plant, gal. per day	50,000	Authorized		Foster Wheeler Co.
Magnolia Petroleum Co., Stephens County, Oklahoma:				
Gasoline plant, cu. ft. per day	30,000,000	Building	Jan. '50	Jones & Laughlin Supply Co.
Magnolia Petroleum Co., Hickok, Kans.:				
Gasoline plant, cu. ft. per day	100,000,000	Building	Jan. '50	Walco Engineering & Const. Co., L. S. Gregory Co.
Magnolia Petroleum Co., Fremont, Tex.:				
Natural-gas processing plant, cu. ft. per day	220,000,000	Building	Aug. '49	Hudson Engineering Corp.
Magnolia Petroleum Co., Grady County, Oklahoma:				
Natural-gasoline-cycling plant, cu. ft. per day	30,000,000	Building	Early '50	
Magnolia Petroleum Co., Jackson County, Texas:				
Compressor station, cu. ft. per day	15,000,000	Building	Late '49	
Magruder, P. S., Operator, Western States gasoline plant, Kings County, California:				
Absorption facilities		Building	1949	J. B. Gill Co.
Northern Natural Gas Co., Buston, Kans.:				
Increase compressor capacity, hp.	1,600	Building		Dresser Engineering Co.
Northern Natural Gas Co., Mullenville, Kans.:				
Increase compressor capacity, hp.	3,200	Building		Dresser Engineering Co.
Northern Natural Gas Co., Clifton, Kans.:				
Additional compressors, hp.	1,600	Building	1949	Fluor Corp.
Northern Natural Gas Co., Oakland, Iowa:				
Gasoline plant, cu. ft. per day	265,000,000	Authorized	1950	J. F. Pritchard & Co.
Northern Natural Gas Co., Palmyra, Neb.:				
Additional compressors, hp.	1,600	Building	1949	Fluor Corp.
Northern Utilities Co., Rock Springs, Wyo.:				
Gas-desulfurization unit, cu. ft. per day	6,000,000	Building	Sept. '49	Graff Engineering Co.
Ohio Oil Co., South Coles Levee, Calif.:				
Gas-lift unit, hp.	1,800	Building	1949	Fluor Corp.
Paloma Operator's Unit, Paloma field, California:				
Extend absorption section, cu. ft. per day	60,000,000	Considering		
Panhandle Producing Co., Hutchinson County, Texas:				
Desulfurization unit, cu. ft. per day	2,750,000	Building	1949	Stacey-Dresser
Pecos Petroleum Co., Texas:				
Compression gasoline plant, gal. per day	5,000	Authorized	Aug. '49	O. L. Olsen
Phillips Petroleum Co., Guymon, Okla.:				
Gasoline plant, cu. ft. per day	173,000,000	Authorized	July '49	
Phillips Petroleum Co., Alvin, Tex.:				
Gasoline plant, cu. ft. per day	120,000,000	Authorized	Sept. '49	
Plymouth Oil Co., Upton County, Texas:				
Gasoline plant, cu. ft. per day	80,000,000	Building	Oct. '49	Hudson Engineering Co.
Pure Oil Co., Andrews County, Texas:				
Gas-processing plant		Authorized		
Reno Oil Co., Holiday, Tex.:				
Gasoline and pressure-maintenance plant, hp.	400	Building	Aug. '49	O. L. Olsen
Richfield Oil Corp., Santa Barbara County, California:				
Compression plant extension, hp.	2,640	Building	1949	Fluor Corp.
Absorption and H_2S removal plant, cu. ft. per day	15,000,000	Building	1949	Fluor Corp.
Shamrock Oil & Gas Co., Hutchinson County, Texas:				
Installing gas-compressor unit, hp.	2,900	Building	July '49	The Shamrock O. & G. Co.
Shell Oil Co., Inc., Denver City, Tex.:				
Gas compression, added absorption, cu. ft. per day	30,000,000	Building	1949	Fluor Corp.
Shell Oil Co., Inc., Capitan field, California:				
Remodel plant		Considering		
Shell Oil Co., Inc., Dominguez, Calif.:				
Remodel plant		Considering		
Shell Oil Co., Inc., Yoakum County, Texas:				
Gasoline-plant extension, cu. ft. per day	24,000,000	Building	Aug. '49	Fluor Corp.
Shell Oil Co., Inc., Wasson field, Texas:				
Gasoline plant, cu. ft. per day	60,000,000	Building	Early '50	Fluor Corp.
Skelly Oil Co., Carson County, Texas:				
Plant expansion		Building	Late '49	J. E. Carlson
Slick-Urschel, Upton-Reagan counties, Texas:				
Gasoline plant, cu. ft. per day	50,000,000	Building	Nov. '49	J. F. Pritchard & Co.
Southern Counties Gas Co., Blythe, Calif.:				
Additional compressor capacity, hp.	3,500	Building	Oct. '49	

HANDLE WASTES the OLIVER

CHANGE

SEPARATOR BOX EMULSIONS

SEPARATOR BOX SLUDGES

TANK BOTTOMS

TRAP RESIDUES

How are you handling your refinery wastes now? Up against any restrictive laws? Too much in value being thrown away?

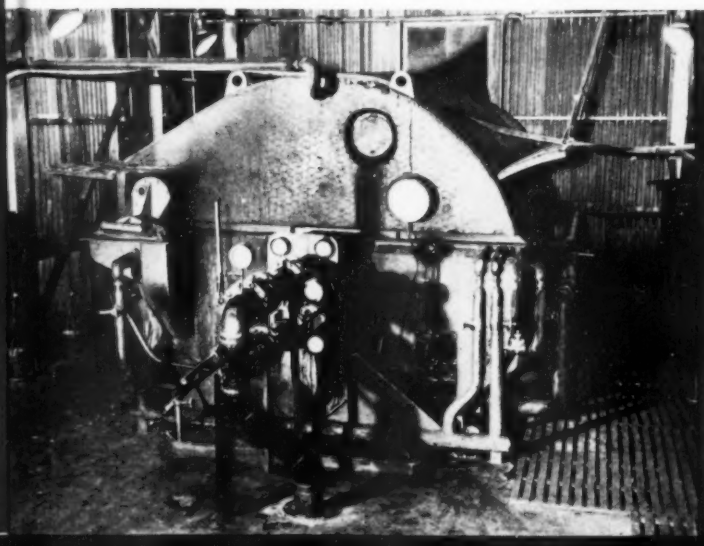
Refinery wastes are a nuisance, and can be an economic loss but trouble disappears and values are recovered when they are handled on the Oliver Vacuum Precoat Filter. This filter has proved itself the solution to the refinery's problem of "What can we do with our wastes?" Operations are continuous, automatic and economical.

For example, one Oliver Filter in service is producing the following results: 2/10 of 1% sludge and only trace of water in the oil phase. The water phase is comparatively oil-free.

This Oliver Precoat Filter is a modification of the Precoat Filter being so successfully used on contact clays, reducing materially both oil losses in the cake and handling costs. This Oliver Precoat Filter is one of nearly a score of basic types of filters designed by Oliver United Engineers for use in the major industries of the world: oil refining, coal and metal mining, pulp and paper, cane and beet sugar, cement, chemicals, sewage treatment, food processing and pharmaceuticals.

Oliver United brings to each filtration problem not only the services of specialists in their respective fields but the broad over-all filtration experience gained by more than 40 years of service to industry.

Oliver Precoat Filter recently installed for handling refinery wastes.



OLIVER UNITED

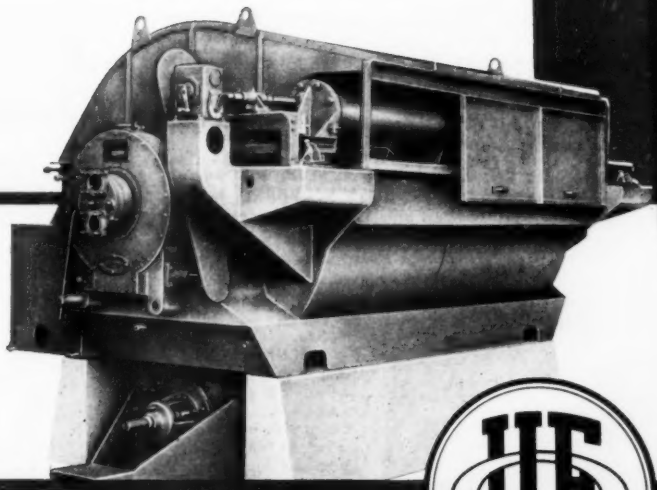
PRECOAT Way...

1...clean oil, acceptable for rerun

INTO

2...low turbidity water, dischargeable into streams or harbors

3...dry, small volume cake, easily handled and ideal for filling



These are photographs of refinery slop oil "before and after" Oliver Precoat Filtration. The left hand bottle shows a representative slop oil containing 50% oil and 50% water, with emulsion stabilized by 6% solids content. The filtrate sample on right, representative of precoat filtration results, shows separation of refinery slop oil into water containing 2 ppm of oil and 35° API gravity oil containing 0.4% BS & W or 0.1% water (by distillation), the oil being acceptable as "rerun" stock.

OF INC.

FILTERS Inc.

Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HO[illegible]LAHOMA CITY • NEW YORK

OUR 29th YEAR

No kelly—*new or old*—should be without a

BAASH-ROSS KELLY SCABBARD

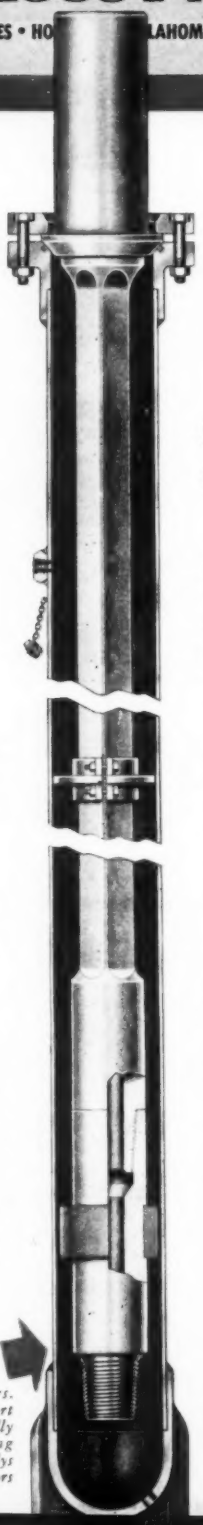
PROTECTS your Kelly against bending

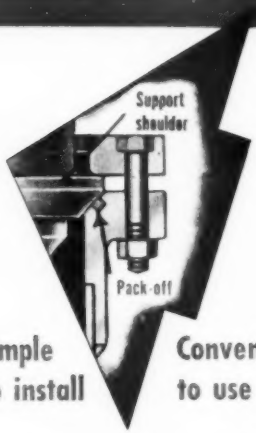
SPEEDS Kelly rig-up and move-out operations

SIMPLIFIES Kelly transportation and storage

A kelly is one piece of rig equipment that is probably more easily damaged when NOT in use than while in operation. Improper storage, or poor support while transporting, can easily bend a kelly so badly as to make it unusable—particularly at modern high table speeds. And once bent it is difficult to restraighten a kelly to its original accurate alignment.

Here's the kelly protection you need, both *on* and *off* the rig—the BAASH-ROSS KELLY SCABBARD. In fact, the Kelly Scabbard is even more than its name implies, for it is also a portable rat-hole *complete with drilling bit and leak-proof circulation passages!*





Simple to install — Convenient to use

As shown above, a double-tapered shoulder is provided on the kelly (either *integral* on new kellys, or *welded* onto older kellys). The Kelly Scabbard not only locks to and is supported by this ring, but also packs-off against it to permit high-pressure circulation through the drilling bit at the bottom without leakage at the top. *Note that no easily-damaged threads are used for connecting the Scabbard and kelly!*

WHEN THE KELLY IS NOT IN USE it remains locked and protected in the Scabbard at all times—in storage, during transportation, and on the pipe rack. The kelly cannot become damaged by careless handling or by improper support because of the rigid protection provided by the Kelly Scabbard!

After moving Scabbard assembly into rig, the kelly can be *permanently* attached to the swivel until completion of drilling. *At no time need the swivel be removed when connecting or disconnecting the Scabbard!*

WHEN RIGGING UP, the Scabbard remains around the kelly and provides a means of both drilling and "casing" the rat-hole in *one* simple operation. Since the Scabbard is equipped with a bit at the bottom, complete with circulation holes, and is tightly packed-off around the tapered ring, full circulation can be maintained through the kelly while drilling the rat-hole, without leakage around the top of the Scabbard.

WHEN READY TO DRILL THE WELL, after completing the rat-hole, it is only necessary to loosen the nuts from the studs and split lock-ring that holds the Scabbard to the kelly. The kelly can then be withdrawn from the Scabbard for drilling operations and, by replacing the split ring to form a protective seat, the Scabbard can be used as a rat-hole throughout all the subsequent drilling operations!

WHEN MOVING OUT after drilling is completed, it is only necessary to reconnect the kelly and Scabbard by means of the simple split lock-ring. Circulation can then be established around the outside of the Scabbard, thus loosening it for quick and easy withdrawal. After removing the Scabbard assembly the kelly, of course, remains inside throughout all subsequent handling, transportation and storage operations until again installed on the next well. *It's simple, convenient, and the ultimate in long-life protection for your kellys!*

NOTES FOR ORDERING

- The Baash-Ross Kelly Scabbard can be used with all types of kellys—square, hexagon, octagon or other types.
- It should be ordered long enough to accommodate the kelly never-out, so the breaking of this connection is unnecessary.
- All the new Baash-Ross kellys can be ordered with integral lock-ring machined on the kelly, together with the complete Kelly Scabbard assembly for shipping.
- Kellys now in use can be easily equipped with a Kelly Scabbard by simply welding a split lock-ring to the upset.
- The Kelly Scabbard is available in four basic types—two to fit plain kellys, and the other with sufficient clearance to accommodate kellys with rubber protectors or fiberglass. Also, rubber protectors can be supplied either with integral, drop-type drive lugs as shown or with a flat lug for use on long very-deep holes. Specify type desired.

OVERSEAS OPERATORS

While a Baash-Ross Kelly Scabbard makes vital savings on *any* drilling program, it is virtually indispensable on overseas operations where transportation and storage facilities are particularly hard on kellys. The Kelly Scabbard is a shipping and transportation "container" as well as a convenient, portable rat-hole!

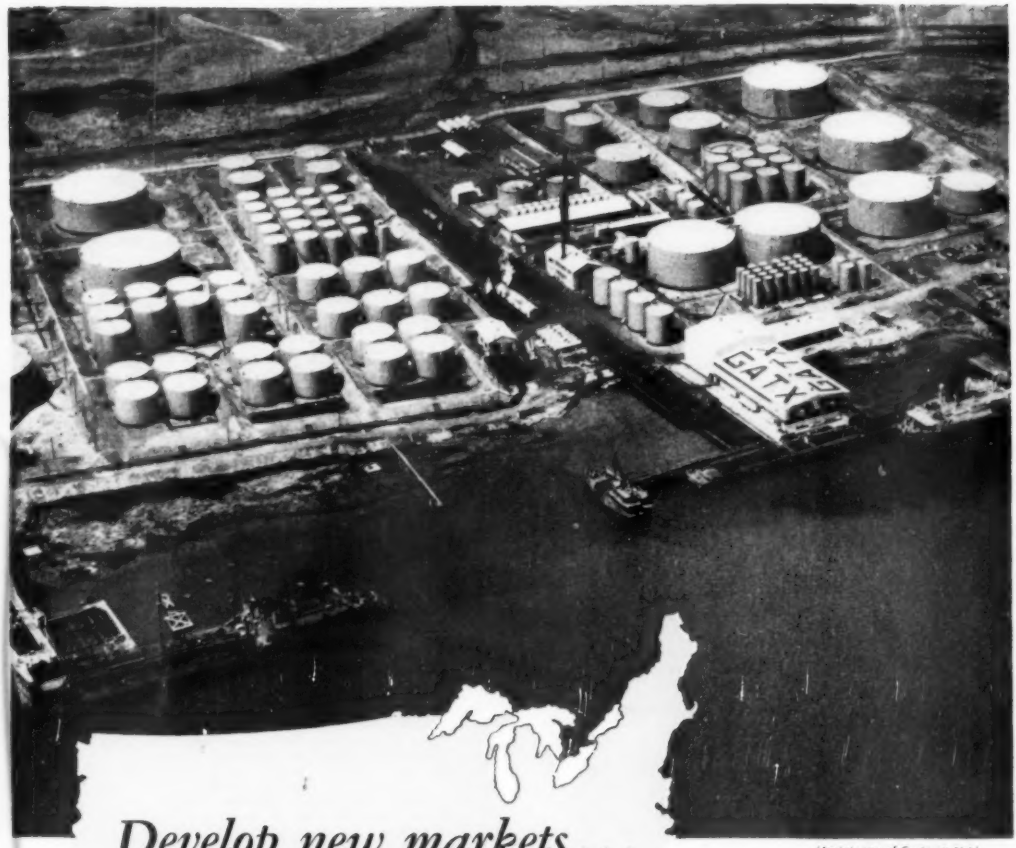
Illustrated is the Baash-Ross Kelly Scabbard providing sufficient clearance for kellys having rubber protectors. Note centralizing support that maintains accurate kelly alignment. A closer-fitting type is also available for kellys where no rubber protectors are used.

NATURAL-GAS PROCESSING PLANT PROJECTS (Continued)

Company, location and type of project—	Capacity rating	Status	Comp. schedule	Contractors
Southern Minerals Corp., Nueces County, Texas:				
Hp. absorption and press.-maintenance unit, cu. ft. per day	56,000,000	Building	Jan. '50	Process Engineers, Inc.
Southern Union Gas Co., Bloomfield, N. M.:				
Gas-dehydration unit, cu. ft. per day	60,000,000	Building	July '49	Graff Engineering Co.
Standard Oil Co. of Texas, Sivells Bend, Tex.:				
Gasoline plant, cu. ft. per day	5,000,000	Building	Mid '49	
Stanolind Oil & Gas Co., Bee County, Texas:				
Cycling plant, cu. ft. per day	166,000,000	Building	July '49	Jones & Laughlin Supply Co.
Stanolind Oil & Gas Co., Hockley County, Texas:				
Natural-gasoline plant, cu. ft. per day	40,000,000	Building	Feb. '50	Brown & Root, Inc.
Stanolind Oil & Gas Co., Andrews County, Texas:				
Natural-gasoline plant, cu. ft. per day	38,000,000	Building	Jan. '50	Jones & Laughlin Supply Co.
Stanolind Oil & Gas Co., Ector County, Texas:				
Natural-gasoline plant, cu. ft. per day	50,000,000	Building	June '50	Stearns-Roger Manufacturing Co.
Stanolind Oil & Gas Co., Chambers County, Texas:				
Compressor plant, cu. ft. per day	14,000,000	Building	Nov. '49	J. F. Pritchard & Co.
Sun Oil Co., Starr County, Texas:				
Gasoline plant, cu. ft. per day	35,000,000	Building	1949	Petroleum Engr., Inc.
Sun Oil Co., Coke County, Texas:				
Gasoline plant, cu. ft. per day	10,000,000	Building	1949	J. F. Pritchard & Co.
Sun Oil Co., Chambers County, Texas:				
Compressor plant, cu. ft. per day	14,000,000	Building	Dec. '49	J. F. Pritchard & Co.
Sun Oil Co., Egan, La.:				
Natural-gasoline plant		Authorized		
Superior Oil Co., Colorado County, Texas:				
Gas-injection plant		Authorized		
Taylor Refining Co., McAllen, Tex.:				
Cycling plant, cu. ft. per day	75,000,000	Building	Late '49	Gasoline Plant Const. Corp.
Texas Co., The, Archer City, Tex.:				
Gasoline plant, cu. ft. per day	3,500,000	Building	Aug. '49	O. L. Olsen
Union Oil Co. of California, Brea Olinda field, California:				
Increase absorption facilities, cu. ft. per day	6,000,000	Considering	1949	
Union Oil Co. of California, Montebello field, California:				
Crude-oil absorption plant, cu. ft. per day	1,000,000	Considering		
United Gas Pipe Line Co., Carthage, Tex.:				
Gasoline plant, cu. ft. per day	100,000,000	Building	Mid '49	Hudson Engineering Co.
United Gas Pipe Line Co., Karnes County, Texas:				
Gasoline plant, cu. ft. per day	10,000,000	Building	1950	Delta Engineering Corp.
West Cement Medrano Unit, Caddo County, Oklahoma:				
Repressuring unit, cu. ft. per day	9,000,000	Building	July '49	Dresser Engineering Co.

REFINERY EXPANSION PROJECTS COMPLETED FIRST HALF OF 1949

Company, location and type of project—	Capacity rating
Ashland Oil & Refining Co., Catlettsburg, Ky.:	
Modernizing catalytic cracking unit, bbl. per day	12,000
Atlantic Refining Co., Philadelphia:	
Modify combination cracking unit	
Atlantic Refining Co., Port Arthur:	
Modify combination cracking unit	
Aurora Gasoline Co., Detroit:	
Revise cat. cracker, bbl. per day	7,000
Revamp thermal reformer, bbl. per day	3,000
Aurora Gasoline Co., Elsie, Mich.:	
Revamp crude unit, bbl. per day	5,000
Carter Oil Co., Billings, Mont.:	
Crude distillation unit, bbl. per day	20,000
Cities Service Oil Co. (Del.), East Chicago, Ind.:	
Delayed coking unit, bbl. per day	17,500
Cat. cracking unit, bbl. per day	14,700
Continental Oil Co., Denver:	
Increase crude oil cap., bbl. per day	7,500
Cosden Petroleum Corp., Big Springs, Tex.:	
Asphalt plant, bbl. per day	2,000
Gas-concentration system, bbl. per day	500
Esso Standard Oil Co., Baton Rouge:	
Debutanizing and splitting unit,	
Cu. ft. per day	6,200,000
Bbl. per day	11,000
Esso Standard Oil Co., Linden, N. J.:	
Vacuum distillation unit, bbl. per day	49,000
Excelsior Refineries, Lloydminster, Alta., Canada:	
Move refinery from McMurray, bbl. per day	3,000
Gulf Refining Co., Toledo:	
Topping and vacuum unit, bbl. per day	32,000
Hancock Chemical Co., Watson, Calif.:	
Sulfur-recovery plant, tons per day	50
Imperial Oil, Ltd., Edmonton, Canada:	
Moving refinery, bbl. per day	6,000
Kanotex Refining Co., Arkansas City, Kans.:	
Catalytic desulfurization-reforming unit, bbl. per day	4,200
Revamp vapor-recovery unit, bbl. per day	1,000
Lion Oil Co., El Dorado, Ark.:	
Topped crude vacuum reducing unit, bbl. per day	7,000
Magnolia Petroleum Co., Beaumont, Tex.:	
Dewaxing unit, bbl. per day	4,800
Solvent-extraction unit, bbl. per day	4,000
Mercury Oil Refining Co., Oklahoma City:	
Crude-oil topping unit, bbl. per day	3,500
McCarthy Chemical Co., Winnie, Tex.:	
Petrochemical plant	
McColl-Frontenac Oil Co., Ltd., Montreal:	
Catalytic cracking and cat. poly. units	
Midland Co-op. Wholesale, Cushing, Okla.:	
Thermal reforming unit, bbl. per day	1,000
Catalytic polymer unit, bbl. per day	200
Old Dutch Refining Co., Muskegon, Mich.:	
Revamp thermal cracking unit	
Pan American Refining Corp. and Mexican Petroleum Corp., Baltimore:	
Replace fractionators (2)	
Pan American Refining Corp. and Mexican Petroleum Corp., Texas City, Tex.:	
Increase desalter capacity	
Special petroleum chemicals unit	
Increase crude handling facilities	
Paraffine Companies, The, Inc., Emeryville, Calif.:	
Asphalt stills (2), bbl.	720
Pennzoil Co., The, Rouseville, Pa.:	
Additional boilers, lb. per hr.	45,000
Petroleum Specialties, Inc., Flat Rock, Mich.:	
Crude-oil fractionator, bbl. per day	6,000
Phillips Oil Co., Kansas City, Kans.:	
Compounding plant	
Pure Oil Co., Nederland, Tex.:	
Lube plant	
Compounding and blending plant	
Rado Refining Co., McAllen, Tex.:	
Crude-oil skimming, bbl. per day	2,000
Republic Oil Refining Co., Texas City, Tex.:	
Polymerization unit, bbl. per day	850
Salt Lake Refining Co., Salt Lake City:	
New refinery, bbl. per day	25,000
Shamrock Oil & Gas Corp., Sunray, Tex.:	
Increase refinery capacity, bbl. per day	5,000
Shell Oil Co., Inc., Wilmington and Martinez, Calif.:	
Gasoline treater	
Extend insecticide plant	
Lube-handling facilities	
Shell Oil Co., Inc., Norco, La.:	
Fractionator, bbl. per day	12,000
Sinclair Refining Co., East Chicago, Ind.:	
Lube-treating plant, bbl. per day	2,500
Dewaxing unit	
Waste-water purification plant	
Sinclair Refining Co., Marcus Hook, Pa.:	
Waste-water purification plant	
Desalting plant	



(Aerial view of Carteret, N.J.)

Develop new markets . . .

at less cost . . . with no investment in equipment

by using General American Tank Storage Terminals

Make no investment. Risk no capital.

Four strategically located terminals can handle any liquid that flows through a pipeline. They provide tanks, pipelines, docks, loading racks, drumming and canning facilities, labor, supervision and administration.

You may enjoy all the privacy and convenience of your own private terminal. General American warehouse receipts represent the highest form of collateral. For financing, storage and distribution suggestions, contact your nearest General American representative.

GENERAL AMERICAN TANK STORAGE TERMINALS

GENERAL AMERICAN TRANSPORTATION CORPORATION • 135 SOUTH LA SALLE STREET • CHICAGO 90, ILLINOIS

TERMINALS AT: Carteret, N.J.; Houston, Texas; Corpus Christi, Texas; Goodhope, La. • **Offices in Principal Cities**

REFINERY EXPANSION PROJECTS COMPLETED FIRST HALF OF 1949 (Continued)

Company, location, and type of project—	Capacity rating
Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.:	
Furfural refining unit, bbl. per day	4,450
Contact filtration unit, bbl. per day	3,000
Socony-Vacuum Oil Co., Inc., East St. Louis, Ill.:	
Gasoline-treating unit, bbl. per day	18,000
Southwestern Oil & Refining Co., Corpus Christi, Tex.:	
Catalytic reforming unit, bbl. per day	5,000
Topping unit, bbl. per day	25,000
Standard Oil Co. of California, El Segundo, Calif.:	
Modernize filling plant	
Standard Oil Co. (Ind.), Whiting:	
Motor-oil facilities	
Stanton Chemicals, Inc., Corpus Christi, Tex.:	
Petrochemical plant, tons per day	50
Sun Oil Co., Marcus Hook, Pa.:	
Oil-storage tanks	
Facilities for handling crude oil—wharves to storage	
Texas Co., Port Arthur, Tex.:	
Alter treating facilities	
Union Oil Co. of California, Wilmington, Calif.:	
Hydrogen sulfide recovery, bbl. per day	30,000
Utah Oil & Refining Co., Salt Lake City:	
Propane deasphalting unit, bbl. per day	10,000
Extend steam-generating plant, lb. per hr.	65,000
Western States Refining Co., North Salt Lake City, Utah:	
New refinery, bbl. per day	1,500
Wilcox Oil Co., Bristow, Okla.:	
Install boiler, hp.	250
Winnsboro Refining Co., Winnsboro, Tex.:	
New refinery, bbl. per day	2,800

NATURAL-GAS PROCESSING PLANT EXPANSION PROJECTS COMPLETED FIRST HALF OF 1949

American Republics Corp., Hardin County, Texas:	
Extend injection system	
Gasoline plant, cu. ft. per day	58,500,000
Apache Gasoline Co., Caddo County, Oklahoma:	
High-pressure absorption, cu. ft. per day	3,500,000
Arkansas Fuel Oil Co., Greggton, Tex.:	
Increase propane recovery	
Arkansas Fuel Oil Co., Panola County, Texas:	
Gasoline-plant capacity increase to, cu. ft. per day	100,000,000
Arkansas Fuel Oil Co., Waskom, Tex.:	
Gasoline-plant capacity increase to, cu. ft. per day	72,000,000
Increase plant capacity, cu. ft. per day	30,000,000
Arkansas Fuel Oil Co., Jefferson, Tex.:	
Gasoline-plant capacity increase to, cu. ft. per day	46,000,000
Arkansas Fuel Oil Co., Bienville Parish, Louisiana:	
L.P.G. capacity increase to, cu. ft. per day	35,000,000
Arkansas Fuel Oil Co., Magnolia, Ark.:	
Increase low-pressure gas input, cu. ft. per day	5,000,000
Atlantic Refining Co., Crane, Tex.:	
Natural-gas processing plant, cu. ft. per day	20,000,000
Barnsdall Oil Co., McFaddin, Tex.:	
Compressor station, hp.	1,500
Barnsdall Oil Co., Bloomington, Tex.:	
Dehydration plant, cu. ft. per day	10,000,000
California Co., Hico, La.:	
Gasoline plant	100,000,000
California Co., Brookhaven, Miss.:	
Gasoline plant, cu. ft. per day	10,000,000
Claiborne Gasoline Co., Lisbon, La.:	
Plant addition, cu. ft. per day	50,000,000
Carthage Corp., Carthage, Tex.:	
Natural-gas processing plant, cu. ft. per day	385,000,000
Continental Oil Co., Crockett County, Texas:	
Gasoline plant, cu. ft. per day	10,000,000
Drillers Gas Co., Burrton, Kans.:	
Desulfurization unit, cu. ft. per day	4,000,000
El Paso Natural Gas Co., Denver City, Tex.:	
Purification unit, cu. ft. per day	70,000,000
El Paso Natural Gas Co., Goldsmith, Tex.:	
Purification unit, cu. ft. per day	50,000,000
General Petroleum Corp., Washakie County, Wyoming:	
Recycling plant, cu. ft. per day	3,000,000
Grimes, Otha H., Trent, Tex.:	
Absorption plant, cu. ft. per day	2,000
Gulf Oil Corp., Keifer, Okla.:	
Extend gasoline plant, cu. ft. per day	11,000,000
Humble Oil & Refining Co., Seeligson field, Texas:	
Gas-injection plant, cu. ft. per day	20,000,000
Humble Oil & Refining Co., Conroe, Tex.:	
Enlarge gasoline plant to, cu. ft. per day	30,000,000
Humble Oil & Refining Co., Katy, Tex.:	
Additional propane absorption facilities	
Humble Oil & Refining Co., Kelsy field, Texas:	
Gas-injection plant, cu. ft. per day	18,000,000
Lea County Water Co., Oil Center, N. M.:	
Expand desulfurization unit, cu. ft. per day	15,000,000
Lion Oil Co., Magnolia field, Arkansas:	
Dehydration unit, cu. ft. per day	15,000,000
Lion Oil Co., Bryceland, La.:	
Dehydration unit, cu. ft. per day	25,000,000
Lion Oil Co., Schuler, Ark.:	
Gas treater, cu. ft. per day	2,000,000
Combination gas and liquid desulf. unit, cu. ft. per day	2,000,000
Lone Star Gas Co., Henderson County, Texas:	
Additional L.P.G. equipment, gal. per day	6,000
Lytle, Robert S., Coalinga, Calif.:	
Hydrogen sulfide removal unit, cu. ft. per day	33,000,000
Magnolia Petroleum Co., Seeligson field, Texas:	
Cycling plant, cu. ft. per day	220,000,000
McCarthy Chemical Co., Winnie, Tex.:	
Second absorption plant unit, cu. ft. per day	100,000,000
Mid-Continent Petroleum Corp., Okfuskee County, Oklahoma:	
Gasoline plant, gal. per day	10,000
Odessa Natural Gasoline Co., Odessa, Tex.:	
Enlarge gasoline plant, gal. per day	26,000
Parade Company, Overton, Tex.:	
Increase capacity, propane recovery, gal. per day	12,500
Phillips Petroleum Co., Goldsmith, Tex.:	
Expand gasoline-plant capacity, cu. ft. per day	40,000,000
Phillips Petroleum Co., Andrews, Tex.:	
Expand gasoline-plant capacity by, cu. ft. per day	24,000,000
Phillips Petroleum Co., Oil Center, N. M.:	
Expand gasoline-plant capacity by, cu. ft. per day	16,000,000
Phillips Petroleum Co., Caddo County, Oklahoma:	
Repressuring plant	
Republic Oil Refining Co., Benavides, Tex.:	
Gasoline plant, cu. ft. per day	10,000,000
Richardson & Bass, Kermit, Tex.:	
Gasoline plant, cu. ft. per day	130,000,000
Shell Oil Co., Inc., Ventura, Calif.:	
Increase gasoline plant, gal. per day	60,000
Shell Oil Co., Inc., TXL field, Texas:	
Gasoline-plant extension, cu. ft. per day	45,000,000
Skelly Oil Co., Eunice, N. M.:	
Increase gasoline plant, gal. per day	60,000
Southern Union Gas Co., Kutz Canyon field, New Mexico:	
Gasoline plant, cu. ft. per day	20,000,000
Stanolind Oil & Gas Co., Hockley County, Texas:	
Gasoline plant, cu. ft. per day	90,000,000
Stanolind Oil & Gas Co., Park County, Wyoming:	
Gasoline plant, cu. ft. per day	12,000,000
Stanolind Oil & Gas Co., Grant County, Kansas:	
Natural-gasoline plant, cu. ft. per day	100,000,000
Sun Oil Co., Chacahoula, La.:	
Compressor plant, cu. ft. per day	2,500,000
Sun Oil Co., N. Cankton, La.:	
Compressor plant, cu. ft. per day	1,300,000
Sun Oil Co., Shuteston, La.:	
Compressor plant, cu. ft. per day	2,750,000
Texas Natural Gasoline Co., Jones County, Texas:	
Gasoline plant, cu. ft. per day	4,500,000
Texas Co., Electra, Tex.:	
Absorption plant, cu. ft. per day	2,000,000
Texhoma Natural Gas Co., Moore County, Texas:	
Gas-compression plant, cu. ft. per day	90,000,000
Union Oil Co. of California, Grimes Canyon, California:	
Gas-injection plant, cu. ft. per day	3,000,000
Union Oil Co. of California, Lompoc field, California:	
Increase gas-injection plant, cu. ft. per day	1,500,000
United Gas Pipe Line Co., Carthage, Tex.:	
Gasoline plant, cu. ft. per day	100,000,000
United Gas P. L. Co., Panola, Tex.:	
Increase plant capacity, cu. ft. per day	250,000,000
Universal Gasoline Co., Madill, Okla:	
Gasoline plant, cu. ft. per day	6,000,000
Warren Petroleum Co., Madill, Okla.:	
Expand plant, cu. ft. per day	20,000,000
Warren Petroleum Corp., Holliday, Tex.:	
Expand plant, cu. ft. per day	20,000,000
Warren Petroleum Corp., Taylor's Corner, Tex.:	
Gasoline plant, cu. ft. per day	6,000,000
Warren Petroleum Corp., Jacksboro, Tex.:	
Gasoline plant addition, cu. ft. per day	3,000,000
Warren Petroleum Corp., Gladewater, Tex.:	
Additional L.P.G. facilities, cu. ft. per day	20,000,000
Warren Petroleum Corp., Maysville, Okla.:	
Gasoline plant, cu. ft. per day	80,500,000
Wescol Oil & Gas Co., Nordheim, Tex.:	
Cycling plant, cu. ft. per day	25,000,000
West Texas Gas Co., Plainview, Tex.:	
Addition to compressor station, hp.	300
West Texas Gas Co., Tahoka, Tex.:	
Addition to compressor station, hp.	300
West Texas Gas Co., Fritch, Tex.:	
Revise gasoline plant	

the MIDYEAR REPORT
Statistical Section

32,300 Miles of Pipe Line Planned; 3,350 Miles Completed This Year

by Paul Reed

Left: Coating and wrapping operations in construction of the Basin and Ozark systems comprising 1,000 miles being completed this month for the transportation of crude oil from Jal, N. M., via Cushing, Okla., to Wood River, Ill. Right: Concrete river clamps weighing 850 lb. each, being installed over cushion plates on 26-in. pipe at a river crossing near Elkins, W. Va., on the 200-mile section contracted by H. C. Price Co. for the 268-mile Clendenin, W. Va.-Rockville, Md., line being built this summer to enlarge the facilities of Atlantic Seaboard Corp. and Virginia Gas Transmission Corp.

PIPE-LINE construction for 1949 is now in full swing with world-wide projects now under way amounting to approximately 7,050 miles. Projects totaling 3,350 miles have been completed already in 1949. Of the 32,300 miles of line planned for the future throughout the world, 23,300 miles are for projects in the United States and 10,300 miles are for projects abroad.

Natural-gas projects planned for the United States totaling 16,900 miles predominate in the activity now planned for the future. Crude-oil lines planned and considered total 4,800 miles; products lines, 1,600 miles.

In foreign countries future lines include the following: crude oil, 4,600 miles; products, 1,400 miles; natural gas 4,300 miles.

The current status of pipe-line construction activity is indicated by the total of 45,850 miles of lines for crude oil, products, and natural gas, including projects already completed in 1949, those now under construction plus undertakings planned for the United States and foreign countries.

The most notable 1949 pipe-line accomplishment is the recent completion of the combined Basin and Ozark systems extending from Jal, N. M., to Wood River, Ill., comprising 1,000 miles of lines which connect with new Texas Pipe Line Co. and Texas Empire Pipe Line Co. projects for increasing delivery capacity at Patoka, Ill., and the Chicago area.

Tables below showing completed lines give total mileage of projects completed in 1949. Other tables show lines under way and planned.

TABLE 1—COMPLETED DOMESTIC CRUDE-OIL PIPE-LINE PROJECTS

Company—	Miles	Inch	Contractor, location, and completion date
Atlantic Pipe Line Co.	35	4-10	McVean & Roberts Pipe Line Const.—Gathering system near Crane, Tex.
Interstate Oil Pipe Line Co.	22	8-12	O. C. Whitaker—Panther Creek Junction to Oklahoma City-Foster to Elmore City, Okla.
Lion Oil Co.	11	2-3-4	Ouachita to Smackover-El Dorado, Ark.
Magnolia Pipe Line Co.	70	3-4-6-8	C. L. Rogers Const. Co.—Gathering system, Howard and Scurry counties, Texas.
Phillips Pipe Line Co.	44	8	Bill Morrison Const. Co.—Wichita, Kans., to Kansas City, Mo., loops, 6-25-49.
Phillips Pipe Line Co.	289	12	Morrison Bros.—Odessa to Borger, Tex., 5-49.
Sinclair Refining Co.	20	3-8	Bill Morrison Const. Co.—Madison, Kans., North, 5-25-49.
Shell Pipe Line Corp. (Ozark)*	435	22	Midwestern, Smith Contracting, Anderson Bros.—Cushing, Okla., to Wood River, Ill.
Shell Pipe Line Corp.	40	14	Latex Const. Co.—Hobbs and Jal, N. M., 7-1-49.

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TABLE 1—COMPLETED DOMESTIC CRUDE-OIL PIPE-LINE PROJECTS (Continued)

Company—	Miles	Inch	Contractor, location, and completion date
Shell Oil Co., Inc.	2	6	Hood Const. Co.—Coffee Canyon, Calif., 3-49.
Shell Pipe Line Corp.	41	14	Latex Const.—Eunice, N. M.
Sinclair Refining Co.	90	2-8	Bill Morrison Const. Co.—Wewoka to Pauls Valley, Okla., 4-25-49.
Stanolind Pipe Line Co.	75	16	C. S. Foreman—Washington, Kans., and Freeman, Mo., loops, 4-49.
Stanolind Pipe Line Co.	62	12	Sheehan Pipe Line Const. Co.—LaPlata, Mo., and Wood River, Ill., loops, 4-49.
Sunray Oil Corp.	8	6⅝	Pipe Line Service Co.—Tussey Sta. to Velma, Okla.
Texas Empire Pipe Line Co.	183	18	H. C. Price Co., Anderson Bros. Const. Co., Bechtel Corp., Conyes Const. Co.—Patoka to Wilmington, Ill.
Texas Empire Pipe Line Co.	47	10	Williams Bros. Corp.—Cushing to West Tulsa, Okla.
Texas Pipe Line Co.†	173	24	Smith Const.—Wichita Falls, Tex., to Cushing, Okla.
Texas Pipe Line Co.	15	10-8-6	Associated Pipe Line Contr., Inc.—Wharton County, Texas, Wharton and El Campo, 5-1-49.

*Ozark Pipe Line System of Shell Pipe Line Corp. and Texas Pipe Line Co. Shell Pipe Line Corp. handled construction. †Basin (Jal-Cushing) 515-mile system of Texas Pipe Line Co., Shell Pipe Line Corp., Empire Pipeline Co., Sinclair Refining Co., Texas Pipe Line Co. handled construction.

TABLE 2—COMPLETED DOMESTIC PRODUCTS PIPE-LINE PROJECTS

Shell Oil Co., Inc.	17	4	Hood Const. Co.—Wilmington to Los Angeles, 3-49.
Sinclair Refining Co.	26	8	John Meehan & Son Const. Co. and Ralph Hopple—Marcus Hook to Philadelphia, 4-49.
Sinclair Refining Co.	270	8	Company crews and outside contractors—Redel, Kans., to Wood River, Ill., recondition crude line for products.
Socony-Vacuum Oil Co., Inc.	7	6	Midwestern Const.—Allentown, Pa., spur.
Socony-Vacuum Oil Co., Inc.	127	6	Associated Cont. & Engr.—Portland to Bangor, Me.
Socony-Vacuum Oil Co., Inc. (Eastern P. L. Div.)	22	6	Midwestern Const.—Malvern to Reading, Pa., 4-49.
Susquehanna Pipe Line Co.	11	6	R. L. Coolsaet Const. Co.—Connecting Detroit Southern Pipe Line-Sun Oil Co. terminal, River Rouge.

TABLE 3—COMPLETED DOMESTIC NATURAL-GAS PIPE-LINE PROJECTS

Home Gas Co.	20	6-10	Britton Const.—Dundee storage field, New York, 6-1-49.
Hope Natural Gas Co.	13	14	Pipe Line Const. & Drlg. Co.—Hastings, W. Va., 7-1-49.
Manufacturers Light & Heat Co.	30	6-12	Britton Const.—Majorsville, Pa., area, 6-1-49.
Manufacturers Light & Heat Co.	12	12-16	Britton Const.—Cannonsburg, Pa., area, 6-1-49.
Minneapolis Gas Light Co.	20	12-16-20	Williams Bros.—Minneapolis.
Panhandle Eastern Pipe Line Co.	198.2	26	R. H. Fulton & Co., R. B. Potashnick & Co., Midwestern Constructors—Okla., Kans., Mo., and Ill.
Phillips Petroleum Co.	177	3-24	Vaughn & Taylor, Hansford Station, Tex., gathering system.
Rocky Mountain Gas Co.	55	8	Dawson & Corbett Pipe Line Welding Co.—Wyoming.
Southern Pipe Line Co.	18	6-7-8	Sheppard-Geiger Const.—Edroy to Saxet, Tex.
United Gas Pipe Line Co.	14	7-8	Brown & Root—West Lake Verret to Oaklawn, La.
United Gas Pipe Line Co.	8	8-10	Wood Eng. & Const.—Panola County, Texas. Connection from Lone Star gasoline plant to United company's Carthage-Longview line.

TABLE 4—COMPLETED FOREIGN CRUDE-OIL PIPE-LINE PROJECTS

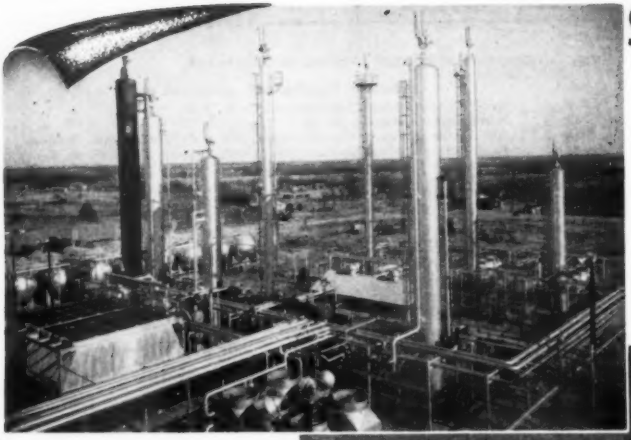
Creole Petroleum Corp.	143	24-26	Williams Bros.—Ule-Amuay, Venezuela.
Richfield Oil Corp.	30	8	Pacific Pipe Line & Engrs., Ltd.—Cuyama Valley field to San Joaquin-Maricopa pipe line.
Richmond Exploration Co.	25	16-18	Williams Bros.—Boscan field to Lake Maracaibo, Venezuela.
Yacimientos Petroliferos Fiscales de Bolivianos	255	6	Williams Bros.—Camiri to Cochabamba to Sucre, Bolivia.

TABLE 5—COMPLETED FOREIGN NATURAL-GAS PIPE-LINE PROJECTS

Petroleos Mexicanos	150	20	Williams Bros.—Poza Rica to Mexico City, Mexico.

TABLE 6—PRINCIPAL DOMESTIC CRUDE-OIL PIPE-LINE PROJECTS UNDER WAY AND PLANNED

Company—	Miles	Inch	Status	Contractor, location, and completion date
Arizona Pipe Line Co.	600	8	Planned	Permian Basin-Phoenix, Ariz.
Atlantic Pipe Line Co.	420	10	Under way	Evans & James—Crane to Harbor Island, Tex., 9-10-49.
Buckeye Pipe Line Co.	82	22	Under way	Anderson Bros.—Lima to Toledo, Ohio.
Buckeye Pipe Line Co.	21	6	Under way	H. L. Gentry Const.—Lawrenceville-Robinson, Ill., 8-49.
Cooperative Refinery Association	48	6	Authorized	Cowley County, Kansas.
Humble Pipe Line Co.	370	16 or 18	Considered	West Texas-Satsuma Sta. to Baytown, Tex., fall of 1951.
Interstate Oil Pipe Line Co.	85	12	Under way	C. B. Edmonds Transportation Co.—Elk Basin to Billings, Mont.
Mid-Valley Pipe Line Co. (Sun and (Sohio)	1,000	20-22	Planned	Longview, Tex., to Mayersville, Miss.-Covington, Ky., to Lima, Ohio.
Pan American Pipe Line Co.	16	6-8	Authorized	Loop, Quitman to Kilgore, Tex.
Pasotex Pipe Line Co.	22	6	Under way	North Snyder field, Texas.
Plains Pipe Line Co.	50	8	Under way	Mush Creek field to Lance Creek field, Wyoming, 9-49.
Portland Pipe Line Co. and Montreal Pipe Line Co., Ltd.	236	22	Planned	Portland, Me., to Montreal, Que., Canada.
Roosevelt Oil & Refining Co. (Simrall Div.)	50	6	Under way	Somerville Const. Co.—Pentwater field, Oceana County, Michigan, south to Woodville in Newaygo County, Michigan.
Shell and other companies	1,000	20	Considered	Wink, Tex., to Wilmington, Calif., 1950-1952.
Shell Pipe Line Corp.	33	12	Under way	Smith Contracting—Wasson Sta., W. Tex., to Hobbs Sta., N. M.
Shell Oil Co., Inc.	4	6	Authorized	Kern Bluff field to Round Mountain, Calif.
Shell Pipe Line Corp.	40	14	Under way	Latex Const. Co.—Hobbs and Jal, N. M.



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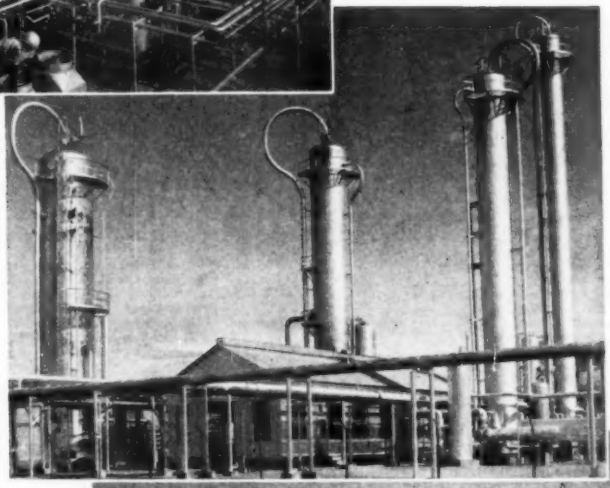
TEXAS



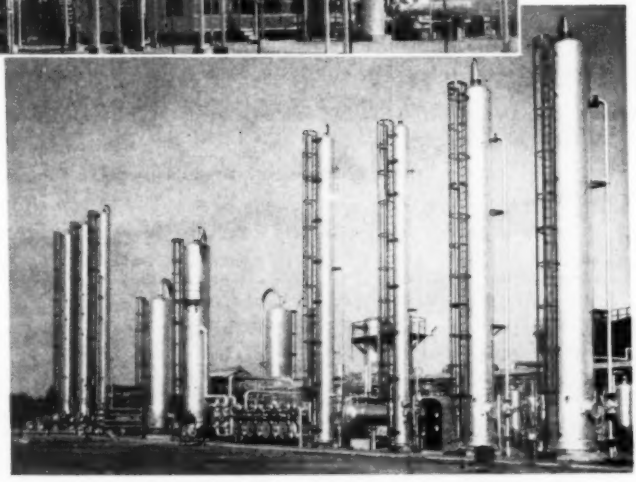


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TABLE 6—PRINCIPAL DOMESTIC CRUDE-OIL PIPE-LINE PROJECTS UNDER WAY AND PLANNED (Continued)

Company—	Miles	Inch	Status	Contractor, location, and completion date
Socony-Vacuum Oil Co., Inc. (White Eagle Div.)	122	8	Considered	Big Horn Basin to Casper, Wyo.
Standard Oil Co. of California	10	10	Under way	Pacific Pipe Line Engrs., Ltd.—Wilmington and Torrance.
Standard Oil Co. of California	16	6 and 10	Authorized	Wilmington to Torrance; West Montalvo to San Buena Ventura, Calif.
Stanolind Pipe Line Co.	31	10-12	Under way	C. S. Foreman—Elmont and Blaine Sta., Kans., loops.
Sun Pipe Line Co.	61	4-10	Authorized	Seabreeze to Sun Station, Tex.
Texas Pipe Line Co.	187	12	Authorized	Wichita Falls to Corsicana, Tex.
Texas Pipe Line Co.	55	22	Under way	Sheehan—Patoka to Wood River, Ill., 8-49.
Texas Pipe Line Co.	36	8	Under way	Latex Const. Co.—Jacksboro, Tex.
Texas-Western Oil Lines, Inc.	1,000	20-24	Proposed	Midland-Odessa area, Texas, to Los Angeles, Calif.
Union Oil Co. of California	20	8-10	Planned	Miscellaneous crude and products.

TABLE 7—PRINCIPAL DOMESTIC PRODUCTS PIPE-LINE PROJECTS UNDER WAY AND PLANNED

Alamo Refining Co.	24	8	Under way	Latex—Sweeney refinery to Freeport, Tex., Gulf Coast.
Buckeye Pipe Line Co.	150	8	Under way	H. L. Gentry Const. Co.—Indianapolis to Lima, Ohio, 12-49.
Connecticut Pipe Line Co.*	40	8	Planned	New Haven to Hartford, Conn.
Plantation Pipe Line Co.	13	8	Authorized	Helena, Ala., to Birmingham.
Phillips Petroleum Co. and Salt Lake Pipe Line Co.	560	8	Planned	Salt Lake City to Pasco, Wash.
Shamrock Oil & Gas Co.*	152	6	Planned	La Junta, Colo., to Denver.
Sinclair Refining Co.	700	8	Planned	Sinclair, Wyo., to Kansas City.
Socony-Vacuum Oil Co., Inc.	18	6	Considered	Christmans to Halzeton, Pa.
Socony-Vacuum Oil Co., Inc.	5	6	Considered	Taylor to Exeter, Pa.
Tuscarora Oil Co., Ltd.	21	10	Under way	Pipe Line Const. & Drlg. Co.—East Waterford, Pa., West, 6-1-49.
Union Oil Co. of California	10	6	Planned	Torrance to Rosecrans.

*Deferred.

TABLE 8—PRINCIPAL DOMESTIC NATURAL-GAS PIPE-LINE PROJECTS UNDER WAY AND PLANNED

Alabama-Tennessee Natural Gas Co.	75	10	Planned	From Tenn. Gas Trans. Co. line near Selmer, Tenn., to Tuscombia, Ala.
Alabama-Tennessee Natural Gas Co.	61	6	Planned	Tuscombia to Huntsville, Ala.
Arkansas Louisiana Gas Co.	163	20	Planned	Waskom, Tex., and Perla, Ark.
Atlantic Gulf Gas Co. (United Gas Pipe Line Co.)	1,530		Planned	Alabama-Florida-Georgia-South Carolina.
Atomic Energy Commission (U. S. Government)	95	12	Under way	Morrison-Haddock Engr. Co.—Bloomfield to Los Alamos, N. M.
Atlantic Seaboard Corp. and Virginia Gas Trans. Corp.	268	26	Under way	H. C. Price, Ray L. Smith & Son—Clendenin, W. Va.-Rockville, Md.
Cabot Carbon Co.	26	10	Planned	McVean & Roberts Pipe Line Const.—Odessa, Tex., 7-15-49.
Carthage Hydrocol, Inc.	63	12-16	Under construction	H. B. Zachry Co.—San Salvador area to Carthage Synthetic Gasoline Plant at Brownsville, Tex.
Central Kentucky Natural Gas Co.	38	12-20	Planned	Kentucky loops, 1949.
Chicago District Pipe Line Co.	41	24	Authorized	Joliet, Ill., to Chicago, 1953.
Cities Service Gas Co.	130	26	Under way	R. H. Fulton & Co.—Newton-Ottawa, Kans.
City of Indianapolis, Inc.	55	16	Proposed	Indianapolis, Ind., to Texas Eastern Transmission Corp. system.
Coast Counties Gas & Electric Co.	40	3-4-8	Under consideration	Coast and valley region, California.
Coastal Pipe Line Co.	1,000		Planned	Texas to Norfolk, Va.
Colorado Interstate Gas Co.	38	20	Planned	Texas Panhandle and Hugoton field, Kansas, to Denver, looping.
Colorado-Wyoming Gas Co.	41		Planned	Greeley, LaSalle, and Windsor, Colo., areas.
Commonwealth Natural Gas Corp.	537	20	Planned	West Bend, Ky., to Norfolk, Va.
Consolidated Gas Utilities Corp.	41	12	Planned	Enid to Blackwell, Okla., Marlow to Cement, Okla.
Continental Oil Co.	35	2-20	Under way	George Tucker Pipe Line Const.—Big Lake, Tex., 9-1-49.
Cooperative Refinery Association	45	4-6	Under way	W. E. Belt Const.—Between Plainville and Phillipsburg, Kans.
Egyptian Natural Gas Co.	80	6-8	Planned	Norris City to Salem-Centralia, Ill., areas.
East Tennessee Natural Gas Co.	398	3-16	Planned	Nashville-Chattanooga-Knoxville, Tenn., and lateral lines.
El Paso Natural Gas Co.	105	24	Authorized	Company crews—Upton County, Texas-Jal, N. M., 10-49.
El Paso Natural Gas Co.	102	26	Authorized	Company crews—Crossover South to Topock, Ariz.
El Paso Natural Gas Co.	450	30	Under way	Company crews—Eunice, N. M.-Blythe, Calif., looping, 1951.
El Paso Natural Gas Co.	451	24	Planned	Farmington, N. M. (San Juan Basin)-Topock, Ariz., 1951.
El Paso Natural Gas Co.	270		Planned	Laterals for San Juan project.
El Paso Natural Gas Co.	130	6-8-10	Under way	Company crews—Wilcox-Globe, Ariz.
Gulf Oil Corp.	40	3-24	Under way	Younger Const. Co.—Eunice, N. M., gathering system and gasoline plant.
Gulfcoast Northern Gas Co.	1,184	26	Planned	Corpus Christi, Tex., area to Rockford, Ill.
Home Gas Co.	70		Planned	Orange, Sullivan-Rockland counties, New York-Cattaragus County, New York, areas.
Hope Natural Gas Co.	32	16	Under way	Pipe Line Const. & Drlg. Co.—Hasting to Clarksburg, W. Va., 8-1-49.
Houston Pipe Line Co.	10	12	Authorized	Houston to San Jacinto field, Texas, fall.
Houston Pipe Line Co.	67		Under way	Latex—Village Mill, Tex., area.
Interstate Natural Gas Co.	29	22-20-16	Under way	Latex Const. Co.—West of Baton Rouge, La.
Interstate Natural Gas Co.	4	8-10	Under way	Krotz Springs, La., area.

TABLE 8—PRINCIPAL DOMESTIC NATURAL-GAS PIPE-LINE PROJECTS UNDER WAY AND PLANNED (Continued)

Company	Miles	Inch	Status	Contractor, location, and completion date
Iroquois Gas Corp.	13	22	Planned	Loops, New York State.
Jersey Central Power & Light Co.	39.4	10	Planned	New Jersey to Coast System of Texas Eastern Transmission Co.'s Big Inch.
Kansas-Nebraska Natural Gas Co., Inc.	210		Planned	Kansas-Nebraska area.
Kansas Light & Power Co.	146	20-22	Under way	M. J. White—Ulysses to Pratt, Kans.
Lavaca Pipe Line Co.	18	6	Authorized	Continental Const.—Pt. Comfort to Francitas, Tex., wrought-iron line.
Lavaca Pipe Line Co.	7	4	Under way	Continental Const.—Matagorda Bay, Tex.
Lone Star Gas Co.	70	20	Under way	Eastern Const.—Opelika to Greenville, Tex.
Manufacturers Light & Heat Co.	5	6	Authorized	Steubenville-Wintersville, Ohio.
Manufacturers Light & Heat Co.	86	6-12	Under way	Williams Bros.—Port Jervis-Nyack, N. Y.
Mesabi Pipe Line Co.	400	18	Proposed	Kinokuk, Iowa-Itasca, Minn.
McCarty Oil & Gas Co.	100	12-13-16-20	Under way	Anderson Bros.—Jackson Pasture to Orange, Tex.
Michigan Gas Storage Co.	113	20	Under way	Mahoney Contr. Co.—Laying 61-mi. Freedona-Laingsburg-Lansing, Mich.
Michigan Gas Storage Co.	180	24	Under way	J. R. Horrigan—Marysville-Grant City, Mo.
Michigan Gas Storage Co.	150	20	Planned	Mahoney Contr. Co.—Chelsia Terminal-Winterfield and Cranberry Lake, Mich.
Michigan-Wisconsin Pipe Line Co.[a]	170	24	Under way	J. R. Horrigan—Sandwich Jct., Ill.-Mount Pleasant, Iowa.
Michigan-Wisconsin Pipe Line Co.[b]	180	22	Under way	J. R. Horrigan—Milwaukee-Burlington, Wis.
Michigan-Wisconsin Pipe Line Co.[c]	180	22	Under way	Oklahoma Contr.—Big Rapids, Mich.-Crown Point, Ind.
Mississippi River Fuel Corp.	215	24	Under way	R. B. Potashnick—Northwest Louisiana to Fredericktown, Mo., looping.
Montana-Dakota Utilities Co.	30	4	Authorized	Saco and Baker, Mont.
Montana-Dakota Utilities Co.	60	3-12	Authorized	Field lines for 1948 construction.
Mountain Fuel Supply Co.	32	20	Authorized	Coalville, Utah, to Salt Lake City.
Natural Gas Co. of West Virginia	5	8	Authorized	Near Salem, Ohio.
Natural Gas Pipeline Co. of America	27	26	Under way	Midwestern Const.—Main-line looping, Iowa and Illinois.
New York State Natural Gas Co.	45	16	Planned	Rasselas to point near State Line Sta., N. Y.
Northern Natural Gas Co.	58	4-24	Authorized	Hugoton and Panhandle fields.
Northern Natural Gas Co.	135	20-24	Under way	C. G. Griffis Const.-Eastern Const.—Iowa, Minnesota, Kansas, Nebraska.
Northern Natural Gas Co.	88		Planned	Kansas-Nebraska looping.
Northwest Natural Gas Co.	750		Planned	Washington, Oregon, and Idaho.
Ohio Fuel Gas Co.	38	16-20	Under way	Mahoney Contr. Co.—Sugar Grove and New Albany, Ohio, 11-15-49.
Ohio Fuel Gas Co.	88	20	Under way	Midwestern, Anderson Bros.—Crawford-Lick Station, Ohio; Lick-South Point stations, Ohio.
Ohio Fuel Gas Co.	48	20	Under way	Mahoney—Mount Gilead to Treat Station; Pavonia Station to Washington, Ohio.
Ohio Fuel Gas Co.	8	18	Under way	Anderson Bros.—Centerville, Ohio, to Station 16, Texas Eastern.
Ohio Fuel Gas Co.	85		Planned	Central Ohio replacement.
Pacific Gas & Electric Co.	47	8	Authorized	Salinas to Kilig City, Calif.
Pacific Gas & Electric Co.	510	30-34	Under way	Bechtel-Price-Conyes—Topock, Ariz.-Milpitas, Calif., 1950.
Panhandle Eastern Pipe Line Co.	131.6	26	Under way	R. H. Fulton & Co.-C. S. Foreman & Co.-Anderson Bros.—Kans., Mo., Ill., Ind., and Ohio, fall 1949.
Panhandle Eastern Pipe Line Co.	252	26	Authorized	Loops from Texas and Michigan.
Peoples Natural Gas Co.	38.3	14	Under way	Williams Austin Co.—Somerset-Johnstown, Pa.
Piedmont Natural Gas Corp.	1,290	20	Planned	Upper Gulf Coast area to Danville, Va.
Potomac Gas Co.	18	16	Planned	Dranesville to Arlington, Va.
San Diego Gas & Electric Co.	53	16	Planned	San Diego County, California, 12-1-49.
San Diego Gas & Electric Co. (Southern Counties Gas Co.)	85		Authorized	San Diego-Riverside-Moreno, Calif.
Southern California Gas Co.	13	30	Under way	Alex Robertson—Rivera to Pasadena, Calif., 12-1-49.
Southern Counties Gas Co.	88	30	Planned	Whitewater to Rosemead, Calif., 12-1-49.
Southern Counties Gas Co.	17	30	Planned	Rivera to Southwest Los Angeles, 12-1-49.
Southern Counties Gas Co.	35	16	Planned	Moreno to San Diego County, Calif., 12-1-49.
Southern Natural Gas Co.	138	20-22	Planned	Chattanooga, Tenn., to Lexington, Miss.
Southern Natural Gas Co.	375	24	Planned	Gwinville, Miss., to Atlanta.
Southern Natural Gas Co.	225	16	Planned	Colfax, Ga., extension.
Southern Natural Gas Co.	61	24	Under way	Latex—Eastern Alabama loop.
Southern Union Gas Co.	32	10-12-14	Under way	R. H. Fulton, H. B. Zachry, J. W. Walton—Albuquerque, Santa Fe, Roswell, N. M., loops.
Southern Union Gas Co.	78	8-10-14	Planned	New Mexico loops and laterals.
Tennessee Gas Transmission Co.	155	30	Authorized	Central Louisiana to northern Tennessee, looping.
Tennessee Gas Transmission Co.	200	30-24	Under way	Morrison Const. Co.-H. C. Price—Looping from Hemphill, Tex., to Monroe, La.
Tennessee Gas Transmission Co.	53.5	30	Under way	Morrison Const. Co.—Harris and San Jacinto counties, Texas, 8-31-49.
Tennessee Gas Transmission Co.	30	30	Under way	Morrison—Sabine River-Pineland, Tex.
Tennessee Gas Transmission Co.	62	24-30	Under way	H. C. Price—Refugio to Victoria, 8-1-49.
Tennessee Gas Transmission Co.	65	16	Planned	Ohio-Pittsburgh spur.
Tennessee Gas Transmission Co.	790	20-26	Planned	Burnaugh, Ky., to Boston, including 395-mile line to Buffalo.
Tennessee Gas Transmission Co.	992	30	Planned	First 150 miles of loops to be laid at Monroe, La.; Greenville, Miss.; Midland and Portland, Tenn.
Tennessee Gas Transmission Co.	47	30	Authorized	Louisiana.
Tennessee Gas Transmission Co.	58	30	Authorized	Mississippi.
Tennessee Gas Transmission Co.	45	30	Authorized	Tennessee.
Texas Eastern Transmission Corp.	122	26	Under way	Associated Pipe Line Contrs.—Lebanon to Somerset Ohio.
Texas Eastern Transmission Corp.	18	8	Authorized	Silsbee and Hastings, Tex., areas.
Texas Eastern Transmission Corp.	7	10-12	Authorized	Lincoln Parish, Louisiana.
Texas Eastern Transmission Corp.	1,400	26	Planned	Texas to Pittsburgh, Pa., loops.
Texas Eastern Transmission Corp.	53	26	Under way	Williams Bros.—Bealville to Woodsfield, Ohio, looping

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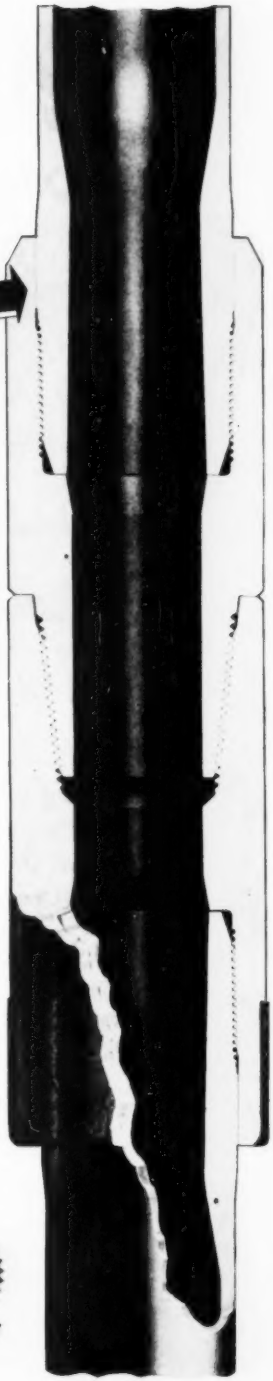

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TABLE 8—PRINCIPAL DOMESTIC NATURAL-GAS PIPE-LINE PROJECTS UNDER WAY AND PLANNED (Continued)

Company—	Miles	Inch	Status	Contractor, location, and completion date
Texas Eastern Transmission Corp.	69	20	Planned	Looping in Beaumont, Tex., and Castor to Lisbon, La., areas.
Texas Eastern Transmission Corp.	100	16	Planned	Provident City field to Lavaca County to Baytown, Tex.
Texas Gas Transmission Corp.	101	26	Under way	Latex Const. Co.—Sharon, La., to Lake Village, Ark., Northeast.
Texas Gas Transmission Corp.	86	26	Under way	O. C. Whitaker Co.—Greenville, Miss., and Leland, Miss.
Texas Gas Transmission Corp.	723	26	Under way	Latex, O. C. Whitaker, J. R. Horrigan, Williams Bros., Midwestern Const.—Lisbon, La., to Middletown, Ohio.
Texas Gas Transmission Corp.	110	20	Under way	N. A. Saigh—Carthage, Tex., to Lisbon, La.
Texas Gas Transmission Corp.	32		Planned	Madisonville to Evansville, Ind.
Texas Illinois Natural Gas Pipeline Co.	1,000	30	Planned	Houston to Joliet, Ill.
Transcontinental Gas Pipe Line Co.†	605	30	Under way	Morrison Bros. Const., Wunderlich & Griffis Const. Co., Midwestern Constructors, Inc.-Williams Bros. Corp.—Texas to New York.
Transcontinental Gas Pipe Line Co.†	1,840		Under way	Main line 70 mi., 20-in.; 460 mi., 26-in.; 1,210 mi., 30-in., Rio Grande Valley, Tex., to New York City.
Transcontinental Gas Pipe Line Co.†	380	8-16	Planned	Laterals to gas field.
Trunkline Gas Supply Co.	711	26	Authorized	Edge, Tex., to Palmyra, Neb., October 1951.
United Fuel Gas Co.	32	20	Authorized	Roane, Calhoun, and Wetzel counties, West Virginia.
United Gas Pipe Line Co.	90	20	Under way	O. C. Whitaker Co.—Baxterville, Miss., to Mobile, Ala., Pensacola, Fla.
United Gas Pipe Line Co.	80	2-4-6	Under way	L. E. Farley Const. Co.—Laterals, North Mississippi.
United Natural Gas Co.	22	22	Authorized	Replacing 12-in. line Elk County, Pennsylvania.
United Natural Gas Co.	29	12	Authorized	Laterals, Elk County, Pennsylvania.
Washington Light Co.	30	6-12	Under way	Britton Contr.—Washington, Pa.

*Michigan-Wisconsin Pipe Line Co. is laying 530 miles of 22 and 24-in. in 1949 contracted by J. R. Horrigan Construction Co. and Oklahoma Contracting Co. for the company's 1,548-mile Hansford County, Texas-Big Rapids, Mich., project scheduled for completion July 1, 1950. †Transcontinental Gas Pipe Line Co. is laying 605 miles of 30-in. in 1949 contracted by Morrison Brothers Construction Co., Wunderlich & Griffis Construction Co., Midwestern Constructors, Inc., and Williams Brothers Corp. This work is the beginning of Transcontinental's 2,220-mile Mercedes, Tex.-New York City project which will include 1,840 miles of trunk line and 380 miles of laterals.

TABLE 9—PRINCIPAL FOREIGN CRUDE-OIL PIPE-LINE PROJECTS UNDER WAY AND PLANNED

Anglo-Iranian Oil Co., Ltd.	56	20-22	Under way	Agha Jari to Mashur, Iran.
Corporacion de Fomento de Chile	45	8	Planned	Cerro Manantiales (Springhill) to Caleta Clarencia (on Bahia Gente Grande).
Inter-Provincial Pipe Line Co. (Imperial)	450	16 or 20	Planned	Edmonton area, Regina, Sask., Canada.
Inter-Provincial Pipe Line Co. (Imperial)	750		Considered	Regina, Sask., to a Lake Superior port.
Imperial Oil, Ltd.	85	4-8	Under way	Sparling-Davis Co., Ltd.—Redwater and Deron, Alta., Canada.
Iraq Petroleum Co., Ltd.	1,080	16	Under way	Company crews—Kirkuk, Iraq, to Haifa, Palestine, and Tripoli, Lebanon.
Iraq Petroleum Co., Ltd.	556	30-32	Planned	Iraq-Levantine Port.
Kuwait Oil Co. (Gulf and Anglo-Iranian)	1,100	30	Planned	Kuwait, Arabia, to Levantine Port.
Kuwait Oil Co. (Gulf and Anglo-Iranian)	600	4-30	Under way	Bechtel-Kuwait, Arabia.
Middle East Pipe Line Co.	800	34-36	Planned	Iran-Levantine Port.
Petroleos Mexicanos	145	12¾	Considered	Reynosa to Monterrey, Mexico.
Petroleos Mexicanos	280	12¾	Authorized	Poza Rica to Salamanca, Mexico.
Santos Jundiai Railroad	30	18	Planned	Santos to Sao Paulo, Brazil.
Trans-Arabian Pipe Line Co.	1,070	30-31	Under way	Bechtel-Abqaiq, Saudi Arabia, to Sidon, Lebanon.
Yacimientos Petroliferos Fiscales de Argentina	400		Planned	Plaza Huincul to Bahia Blanca, Argentina.

TABLE 10—PRINCIPAL FOREIGN PRODUCTS PIPE-LINE PROJECTS UNDER WAY AND PLANNED

Petroleos Mexicanos	160	10¾	Authorized	Minatitlan to Salina Cruz, Mexico.
Cia. des Pipe Lines Petroliers Francias	150	10	Planned	Le Havre to Paris, France.
Colombian Government	342		Planned	Puerto Berrio to La Dorada, 92 mi.; La Dorada to Bogota, 110 mi.; La Dorada to Cartago, 140 mi.
Creole Petroleum Corp.	10	8	Authorized	Catia de la Mar to Nueva Caracas, Venezuela.
Ministry of Petroleum of Colombia and Antioqua R.R.	107		Planned	Puerto Berrio to Madellin, Colombia.
Queont Pipe Line Co.	330		Planned	Montreal, Que., to Toronto, Ont.
Santos Jundiai Railroad	40	10	Planned	Santos to Sao Paulo to Campinas, Brazil.
Svenska Enterprenad Aktiebolget	220		Planned	Uddevalla to Vasteras, Sweden.
United Kingdom Government	150	6	Under way	Shell Petroleum Co. supervision Mtwara, near Lindi, to Ground Nuts area, Tanganyika, Africa.

TABLE 11—FOREIGN NATURAL-GAS PIPE-LINE PROJECTS UNDER WAY AND PLANNED

Direccion General del Gas del Estado	500		Planned	Plaza Huincul to Neuquen, Argentina, to the vicinity of General Conesa, Argentina.
Direccion General del Gas del Estado	1,100	10	Under way	Tecnica and government crews—Comodoro Rivadavia-Buenos Aires, Argentina.
Northwest Natural Gas Co.	600	24	Planned	Alberta fields to Vancouver, B. C., Seattle, Wash., and Portland, Ore.
Petroleos Mexicanos	205	16	Under construction	Monterrey to Torreon, Mexico.
Petroleos Mexicanos	260	20	Under construction	Monterrey-Tampico-Poza Rica area, Mexico.
Petroleos Mexicanos, Mexican Gas Co., and Industrial Gas Co.	600		Planned	Reynosa, Tamaulipas to Mexico City, D.F., Mexico.
Regie Autonome des Petroles	114	6	Under way	Toulouse-Bordeaux, France.
U.S.S.R. (reported)	360		Under way	Dashiva (in Carpathians) to Kiev, Ukraine.
Westcoast Transmission Co., Ltd.	1,400	30	Planned	North Alberta, Vancouver, B. C., and northern California.
Western Pipe Lines	710	22-24	Planned	Alberta fields, Saskatoon, Alta., to Winnipeg, Man., Canada.

Aerial view of the marine basin at the Kure Beach, N. C., corrosion-testing project, maintained jointly by International Nickel Co. and Dow Chemical Co. At this section of the testing station, sea-water immersion, atmospheric spray, and velocity tests are conducted on thousands of samples

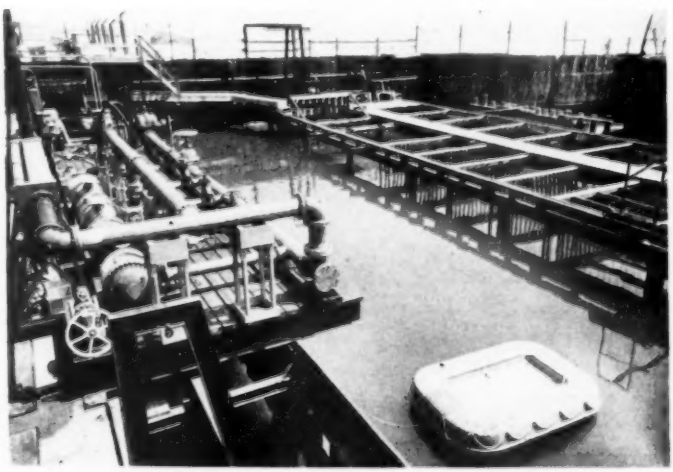
. . . Show Practical Results

by George Weber
Refining Editor

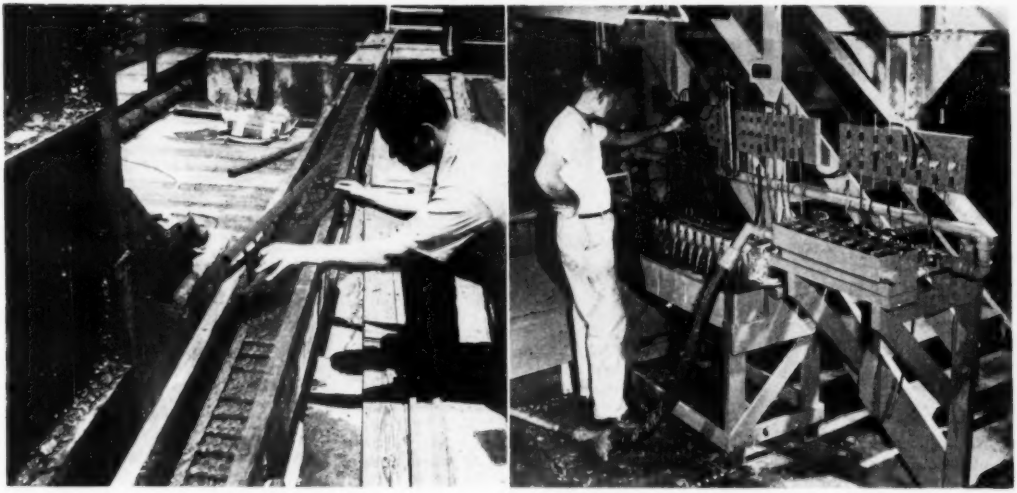
THE petroleum industry is showing increased interest in the important studies conducted at the Kure Beach corrosion testing project. Established nearly 15 years ago by International Nickel Co., this research station is now jointly maintained by Inco and Dow Chemical Co. A significant feature of the project is that facilities are open to use by Government and industry at large for constructive studies combating corrosion.

Research at Kure Beach which is located southeast of Wilmington, N. C., is directed primarily to corrosion by clean sea water free of chemical and industrial wastes. Atmospheric tests are also conducted both inland and at the beach. In addition, marine growths are studied at a separate station located at nearby Wrightsville Beach.

The Kure Beach station is located at the site of Ethyl Dow Chemical Co.'s wartime bromine-extraction plant which processed tremendous volumes of sea water. The protected tidal basin formerly used for salt-water intake now serves the station as a testing basin where thousands of samples of coated and uncoated alloys and metals are completely or partially immersed in sea water exposed to tidal movement. An adjacent building which housed pumps is now equipped with devices for testing



In this tidal basin specimens are completely and partially immersed in clean sea water. At the left is a bank of oil coolers, where cathodic protection of condenser tubes is under test



Left: Low-velocity tests of various samples are conducted in this extensive trough system through which sea water flows at a fixed rate. Right: High-velocity impingement tests here test the resistance of condenser tubes and alloy samples to jet action of sea water

metals and coatings over a wide range of sea-water velocities and jetting speeds. A large outside test rack nearby exposes samples to atmospheric and sea-spray conditions.

About 800 yards inland is a 1-acre fenced lot which will provide space for 40 racks or 36,000 specimens exposed to normal atmospheric corrosion. Nearby is the laboratory where samples are weighed and examined periodically and where complete records of all work are cataloged and compiled. *(For further details on the station, see Te Oil and Gas Journal, June 28, 1947, page 107).* The Kure Beach project was developed by F. L. LaQue, who directs all corrosion test studies. LaQue, a past president of National Association of Corrosion Engineers, heads the corrosion engineering section of International Nickel Co.'s development and research division.

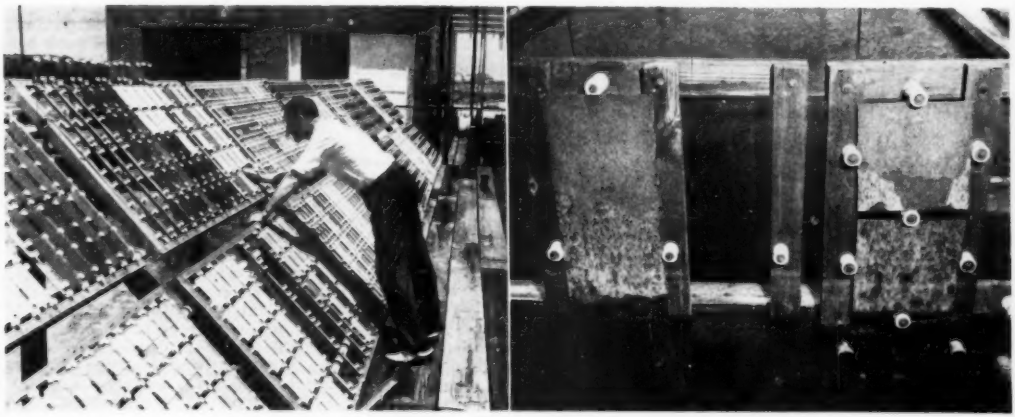
Contributions to Oil Industry

Recent developments in the exploration, development, and refining of petroleum enhance the industry's interest in sea-water corrosion. Marine exploration and drilling expose millions of dollars worth of structural platforms, barges, and equipment to sea-water corrosion. The growing shortage of fresh water in many industrial coastal areas makes the use of sea water an economic necessity for cooling purposes. In these applications alone, important findings have already come out of the Kure Beach studies, and continuation of the long-term research efforts there may well add to the success in preventing further corrosion losses due to sea water action.

Of particular interest to offshore drillers are the results of cathodic-protection investigations, directed by Hilary Humble of Dow Chemical Co. These studies concerned the use of both zinc and magnesium. The latter, with a high current potential, is gaining new recognition and application.

(Continued on page 324)

Left: This spray-test platform at the beach exposes samples to corrosive salt spray and atmospheric tests. Right: Side-by-side tests of continuous and isolated samples of identical metals have proved widely different corrosion rates and disproved early testing methods of small samples for application to piling, bulkheads, etc.



A Critical Analysis of Methods of

DETERMINATION OF WATER DEW POINT

in Hydrocarbon Gases

by Fred C. Riesenfeld and Henry D. Frazier

the MIDYEAR REPORT Engineering Reference Section

MANY processes through which natural gas must pass on its way from the well to its ultimate use are in some may affected by its water content. Some of these processes are gas compression, absorption of gasoline, certain catalytic conversions, low-temperature fractionation, acid-gas removal, dehydration, and transmission in pipe lines. In many of these processes a high water content causes considerable difficulty such as corrosion and plugging of lines due to the formation of ice and hydrocarbon hydrates. Prevention of hydrate formation is of particular importance in the operation of gas-transmission lines, the number of which has increased considerably during recent years. Most of these lines are operated at relatively high pressures and subjected to wide variations of temperature, conditions which are conducive to the formation of hydrates.

Because of the considerable importance of the control of water content of gas streams, and the wide applicability thereof as just outlined, there are a great many installations in operation which reduce such water content to some degree. Successful control of such operations depends upon suitable methods for determining the water content of the treated gas stream, and it is the purpose of this article to discuss such methods and their significance.

Reduction of the water content of natural gas has been accomplished in general by three methods. One of these methods consists of the use of solid adsorbents such as calcium chloride, lithium chloride, magnesium perchlorate, calcium sulfate and others. These materials, in general, are nonregenerable in place and must be removed from the contact vessel and regenerated or discarded.

Second type of dehydration process utilizes solid adsorbents such as activated alumina and silica gel. These materials are somewhat more economical in large operations since they can be regenerated in place by the use of high - temperature gas or steam.

Third type of dehydration process, which at present is most widely used in large operations,

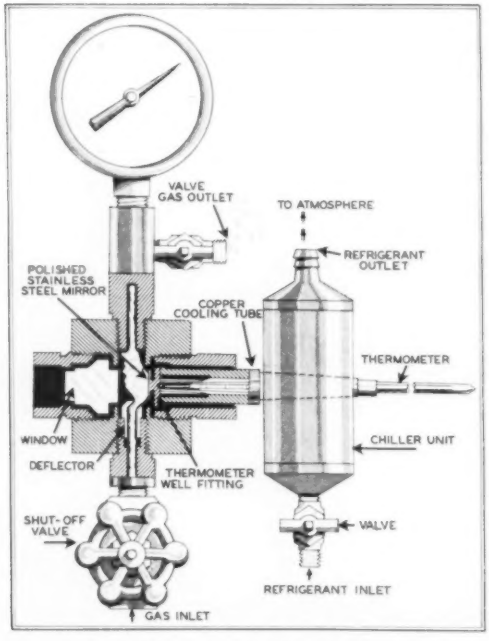


Fig. 1—Bureau of Mines dew-point indicator

F. C. RIESENFELD

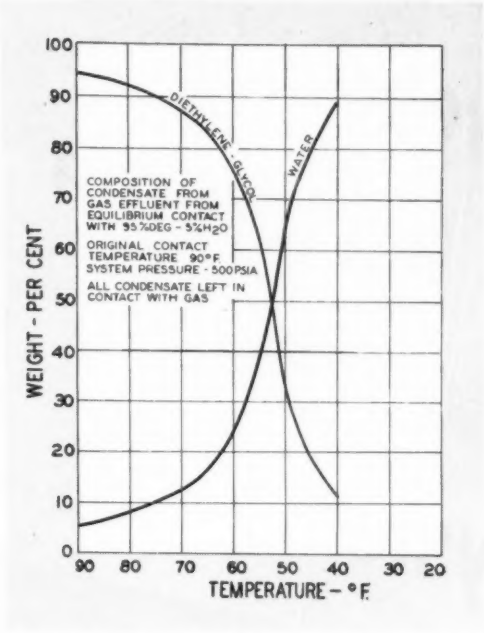
H. D. FRAZIER

The authors have found that the values obtained from conventional dew - point determination apparatus do not give true results when used on gases effluent from liquid dehydraters. A theoretical explanation for this phenomenon and a description of a method for determining the absolute water content of gases from this type of dehydrator is offered. Particular emphasis will be placed upon the phenomena observed when the Bureau of Mines dew-point indicator is used and upon the lack of significance and reproducibility of the results obtained. Reference is also made to a lack of correlation of the indicated water content with the hydrate formation temperature of such gases.

The authors are research chemist and research chemical engineer, respectively, for Fluor Corp., Ltd. Paper presented at the May 5 meeting of the C.N.G.A., Los Angeles.

Fred C. Riesenfeld is research chemist with Fluor Corp., which company he joined in 1944. His work has been in general chemical research, development of new and adaptation of conventional analytical procedures, gas analyses, research on corrosion of ferrous and nonferrous alloys, and testing of commercial plants involving analyses of liquid and gas streams.

Henry D. Frazier, research chemical engineer with Fluor, joined the company in 1944, since which time he has occupied himself with development of analytical methods, physical properties of compounds and solutions, pilot-plant operation and design for natural-gas purification and catalytic processes, corrosion of metals, and field service studies in performance of gas-purification and dehydration plants.


WEIGHT - PER CENT
TEMPERATURE - °F.
DIETHYLENE GLYCOL
WATER
COMPOSITION OF CONDENSATE FROM GAS EFFLUENT FROM EQUILIBRIUM CONTACT WITH 95%DEG - 5%H2O
ORIGINAL CONTACT TEMPERATURE 90°F
SYSTEM PRESSURE - 500PSIA
ALL CONDENSATE LEFT IN CONTACT WITH GAS

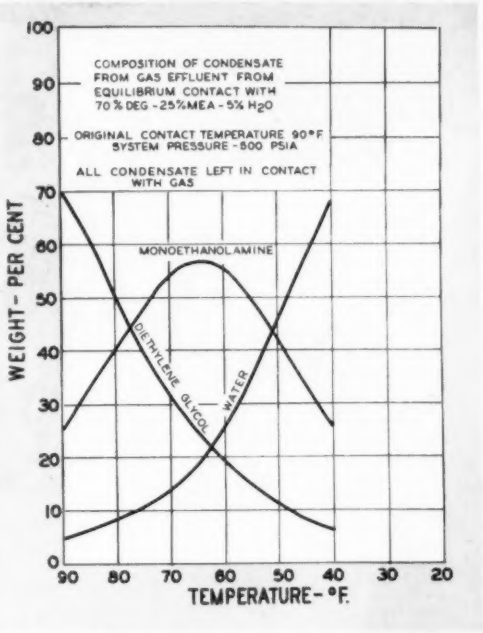

WEIGHT - PER CENT
TEMPERATURE - °F.
COMPOSITION OF CONDENSATE FROM GAS EFFLUENT FROM EQUILIBRIUM CONTACT WITH 70% DEG - 25%MEA - 5% H2O
ORIGINAL CONTACT TEMPERATURE 90°F
SYSTEM PRESSURE - 500 PSIA
ALL CONDENSATE LEFT IN CONTACT WITH GAS
MONOETHANOLAMINE
DIETHYLENE GLYCOL
WATER

Fig. 2—(Left) Condensate due to cooling of dehydrated gas (DEG and water). Fig. 3—(Right) Condensate due to cooling of dehydrated gas (DEG, MEA and water)

employs hygroscopic organic liquids such as diethylene glycol, or diethylene glycol-ethanolamine mixtures. Diethylene glycol is used where dehydration alone is needed and glycol-amine mixtures where acid gas removal is desired in same operation.

Any of the dehydration processes requires analytical control and a number of methods and instruments have been developed to give an indication of the water content of the treated gas.

Two types of these instruments are so designed that the actual operation is intended to give an indication of the temperature and pressure at which the first liquid water will drop out of the gas. This temperature and pressure is commonly referred to as the dew point. Before the advent of liquid dehydrating processes this dew point could be used without further interpretation in cases involving the temperature of formation of natural-gas hydrates since the latter cannot form without liquid or solid water present, even though the temperature be below the hydrate formation point. For this reason we find the efficiency of dehydrating processes expressed in terms of "dew point depression."

One such type of instrument maintains a constant system pressure and manipulation involves the lowering of the temperature to the point of formation of a visible film or droplets on a highly polished cool surface. Temperature at which the first darkening of the surface occurs is taken as the dew point. This kind of instrument may be referred to as the "temperature variant type." The most commonly used instrument of this type is the Bureau of Mines apparatus for determining the dew point of gases under pressure, described by W. M. Deaton and E. M. Frost, Jr., (Fig. 1).

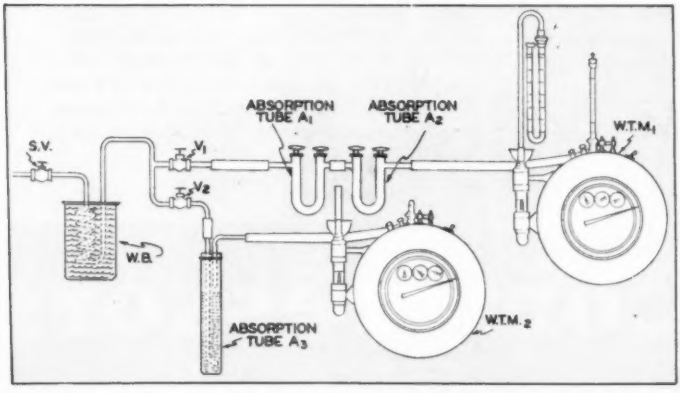
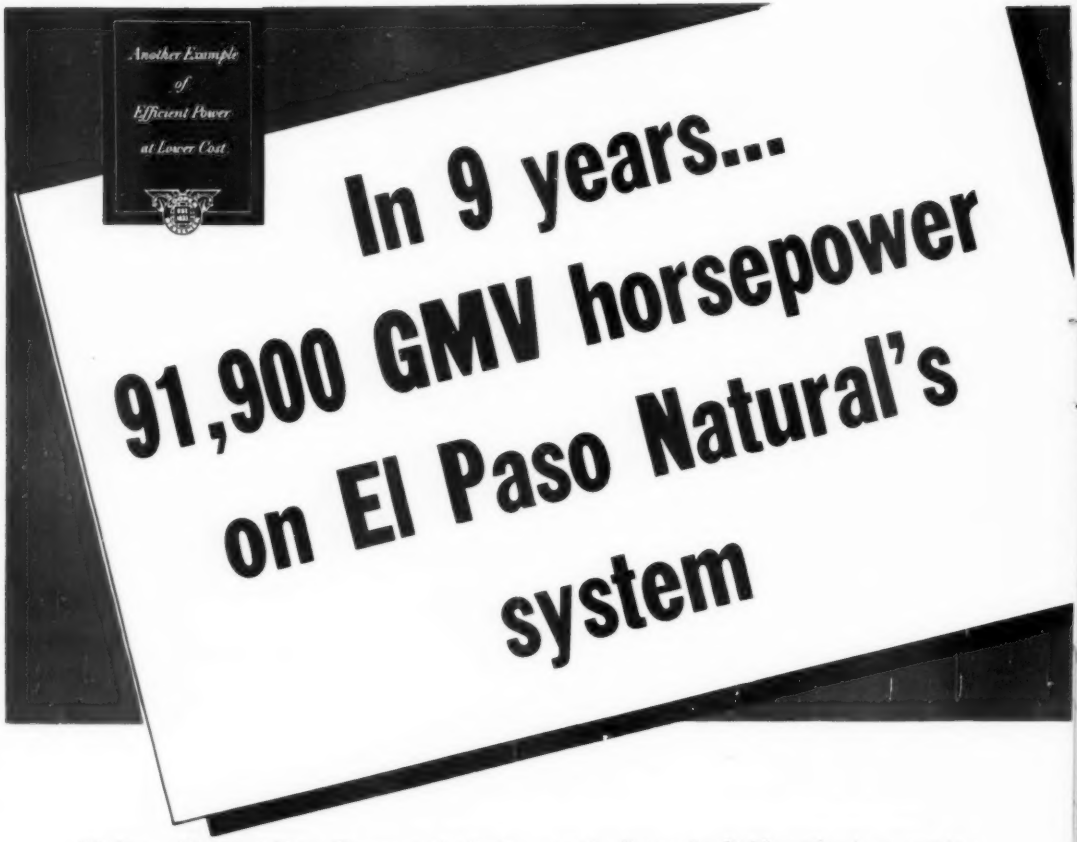


Fig. 4—Equipment for determination of water content of hydrocarbon gas streams

Pressure-Variant Type

Another such type of instrument for the determination of the dew point or water content utilizes an essentially adiabatic expansion from a predetermined pressure and ambient temperature to produce a visible fog in the gas when the predetermined pressure has been set just above the dew-point pressure. This type can be referred to as the "pressure variant type" in that it determines a pressure at which a liquid phase will



In 9 years... 91,900 GMV horsepower on El Paso Natural's system

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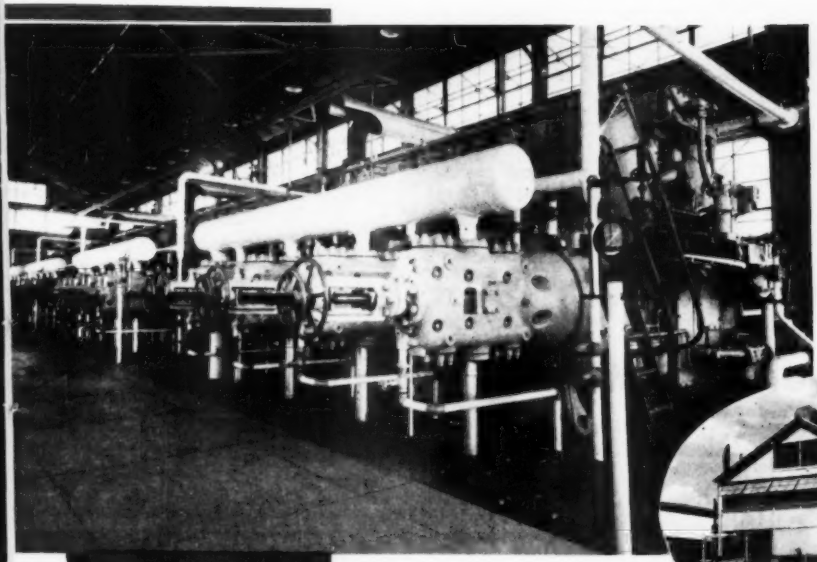
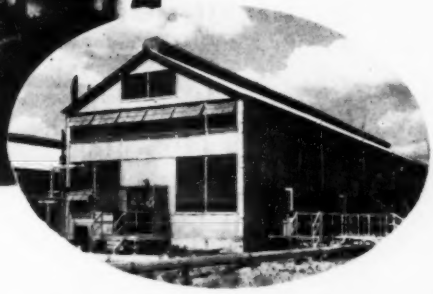
Wherever you go, wherever you check, you'll find a keynote of satisfaction in GMV performance—the result of combining in this modern unit those qualities most desired in compressor service. That's why companies like El Paso Natural turn again and again to modern Cooper-Bessemer V-angles as their needs expand.

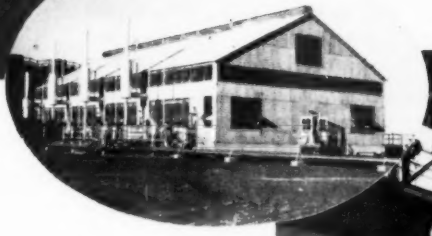
V ANGLE Compressors

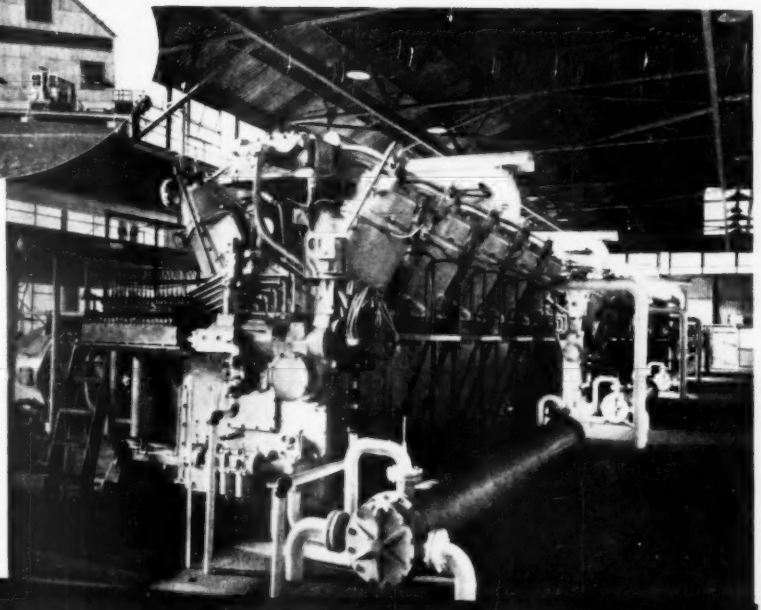
New York Washington Bradford, Pa. Parkersburg, W. Va. San Francisco, Cal. Seattle, Wash.



El Paso Natural's Kermit station, containing 7 GMV 8-cylinder V-angles totaling 5600 compressor hp. Each drives 4 double-acting compressor cylinders, one for each crankthrow. Three piston-type variable unloaders per unit allow even loading throughout pressure range.







El Paso Natural's Fullerton station, containing 6 GMV 10-cylinder V-angles totaling 6,600 compressor hp. Each unit has 4 compressor cylinders for 2-stage compression from 40 to 600 psi.

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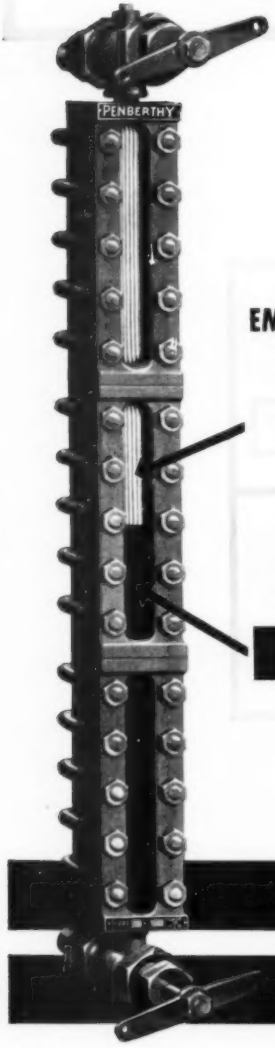
YOU CAN READ

the PENBERTHY Reflex GAGE as far as you can distinguish between BLACK and WHITE



There can be no mistake in reading the Penberthy Reflex Gage. Due to the optical effect of the prismatically grooved glass, the liquid always shows black, and the empty space white. This optical effect is unvarying and absolutely sure. As a result, you can read the gage correctly as far as you can distinguish black and white . . . read it at a glance. There is no squinting to see the meniscus . . . the dividing line between liquid and empty space is always sharp and unmistakable.

In addition to standard units, Penberthy Reflex Gages are also fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. They conform with API-ASME requirements.

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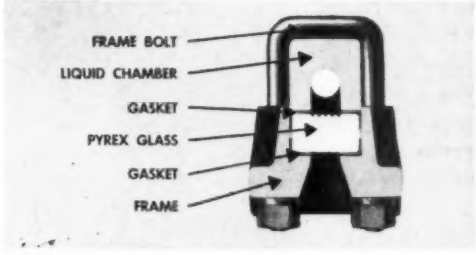

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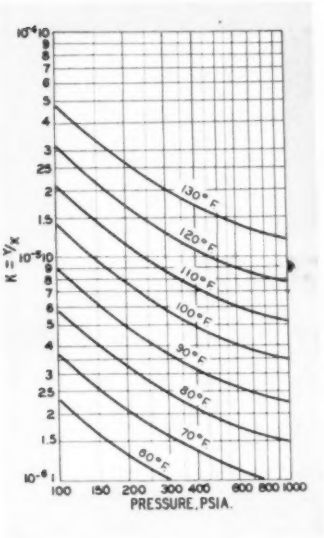

Fig. 5—Vapor-liquid equilibrium chart, diethylene glycol

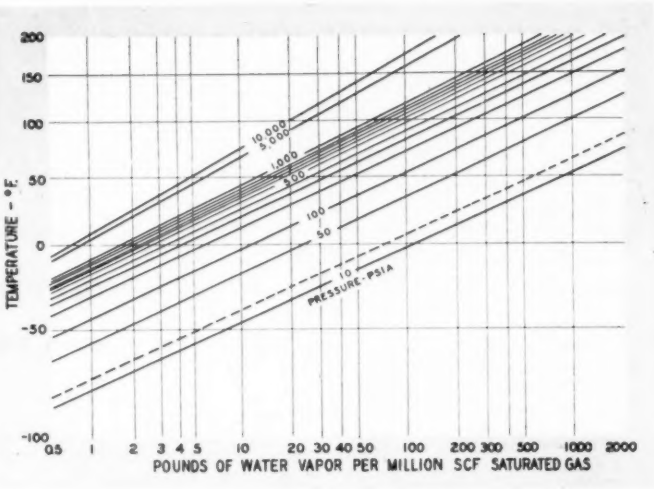

Fig. 7—Water content of gas

form at the temperature of the cell.

A good many methods may be placed in a third class. These include types which rely upon some property of water, other than the condensation phenomenon, which is different from the properties of the other compounds present. Todd and Gauger[10] offer a method in which the water content of gas is determined by infrared spectroscopy. Dunmore[11] and Weaver and Riley[11] describe procedures utilizing the variation in electrical conductivity of a hygroscopic film with varying amounts of water absorbed at different water partial pressures in the gas.

Several methods involving chemical reactions specific for water, are reported in the literature. Among the chemicals used are cobalt bromide[6], Karl Fischer[6] reagent, which consists of a methyl alcohol solution of iodine, sulfur dioxide, and pyridine, magnesium nitride[10] and a mixture of acetyl chloride and pyridine[10,7]. Russell, Reid and Huntington[11] in their work on vapor-liquid equilibria between natural gas and 95 per cent diethylene glycol absorb water and glycol vapor on anhydrous magnesium perchlorate and determine the glycol separately by oxidation with potassium dichromate.

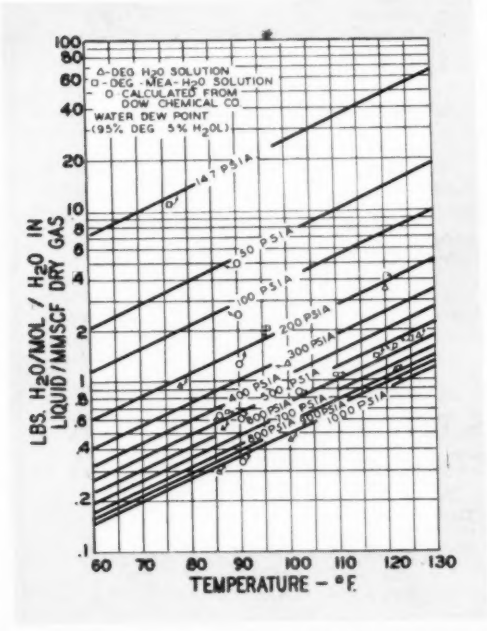

Fig. 6—Water content of gas from liquid dehydration systems

All of these instruments and methods are quite satisfactory for most gas streams which have been dehydrated by means of the first two methods previously mentioned above. However, if the gas has been treated with glycol or glycol-amine mixtures these methods may not give results capable of interpretation in terms of true water content.

The electrical-conductivity type instrument may be used with some degree of success on gas streams contacting diethylene glycol only but it is not usable on those effluent from glycol-amine dehydrating plants, since amines are also conductors of electricity.

This discussion is directed primarily toward the pressure variant, and the temperature-variant types of instruments, since they are in the most common use in the field. Since the phenomenon encountered in their use on liquid dehydrated gas streams is essentially the same with either type of instrument, we will use the temperature-variant type—in particular the Bureau of Mines dew-point indicator—as an example. The instrument does not yield a true water dew point and the value obtained is not accurately indicative of the water content of a gas which has been in equilibrium contact with a diethylene glycol or diethylene glycol - monoethanolamine containing solution.

Theoretical Considerations

The reason for this conclusion is based on the following theoretical considerations. The gas leaving the top of the contactor of a glycol or glycol-amine plant has approached equilibrium with the solution at the

(Continued on page 330)

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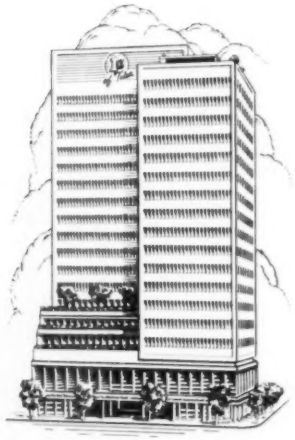

1895 — 1st of Tulsa — 1949

STATEMENT OF CONDITION

June 30, 1949

RESOURCES

Cash and Due from Banks	$55,015,853.54	
U. S. Government Securities	67,397,999.79	$122,413,853.33
Other Bonds and Securities		5,848,313.25
Loans and Discounts		48,104.910.91
Federal Reserve Bank Stocks		180,000.00
Income Earned, Not Collected		365,939.33
Bank Premises		1.00
Future Banking Quarters and Fixtures		1.00
Customers' Liability Under Letters of Credit		674,841.65
Other Resources		21,038.23
		$177,608,898.70

LIABILITIES

Deposits:	Individuals, Firms and Corporations	$129,997,616.23	
	Banks	24,344,727.54	
	Public Funds	13,157,373.70	$167,499,717.47
Income Collected, Not Earned			196,082.72
Taxes, Interest and Expense—Accrued			642,703.84
Letters of Credit Outstanding			674,841.65
Capital		$2,000,000.00	
Surplus		4,000,000.00	
Undivided Profits and Reserves		2,595,553.02	8,595,553.02
			$177,608,898.70

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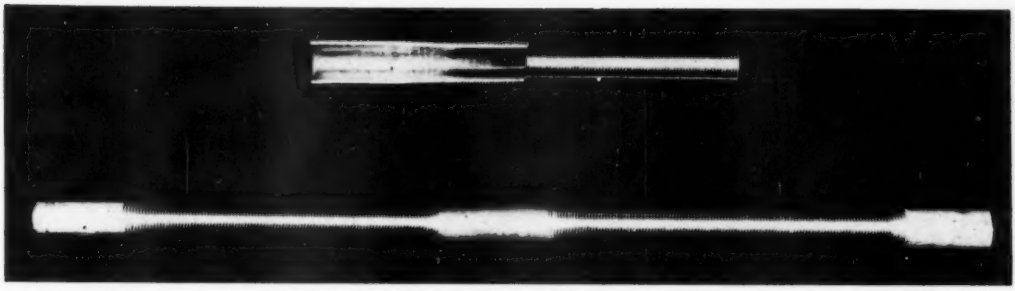


Fig. 1—Finned tube showing plain ends and plain section for spacer plate, lower. Cutaway section of tube showing plain end and finned portion, upper

Design of Finned Tube Exchangers and Condensers

by Dr. L. Katz and R. B. Williams

Low finned tubes may be used in conventional shell-and-tube condensers and exchangers. These tubes have about two and one-half times as much outside surface as the plain tubes. Methods of computing condensing coefficients on finned tubes are presented. Design methods including use of fin efficiencies are given by example calculations.

The authors are with the department of chemical engineering, University of Michigan, Ann Arbor.

FINNED tubes may be used in any shell-and-tube exchanger or condenser. An increase in the heat exchange over that obtained with plain tubes may be expected with the amount of the increase depending upon the ratio of the inside to the outside coefficient, the heat flux, and the degree of fouling. Finned tubes having about two and one-half to three times the outside area of the plain tubes give the greatest increase in heat transfer when the outside coefficient is relatively low.

Fig. 1 shows an integral spiral finned tube with plain ends slightly larger than the diameter over the fins. Table 1 lists the dimensions of these tubes which may be formed of the usual metals: copper, brass, admiralty, steel, etc. The most common tube has 16 fins per inch with fins $\frac{1}{8}$ in. high. The operation by which the fins are formed from a thick walled tube permits leaving a plain section of tube at intervals such as might be required for spacer plates. Many varieties of tubes having higher fins, either longitudinal or spiral, are available, but in general, they require special construction. This paper will present a discussion of coefficients for finned tubes, in general, but designs will be considered only for the low finned tube in conventional shell-and-tube units.

Estimation of Coefficients

Condensation coefficients have been shown to follow Nusselt's relationship modified for finned tubes.[2,6] Armstrong[1] has shown that the outside film coefficient in exchangers using finned tubes is at least as large as that used for plain tubes when the fluid velocity exceeds 1 ft. per second.

Condensation.—For condensation on single horizontal spiral finned tubes, the tube surface may be treated as a combination of horizontal and vertical surfaces. The sides of the fins are vertical surfaces which may be treated by the Nusselt equation for vertical surfaces. The average length of the liquid flow (L) is taken as the area of one side of the fin divided by the diameter over the fin.

Horizontal tube:

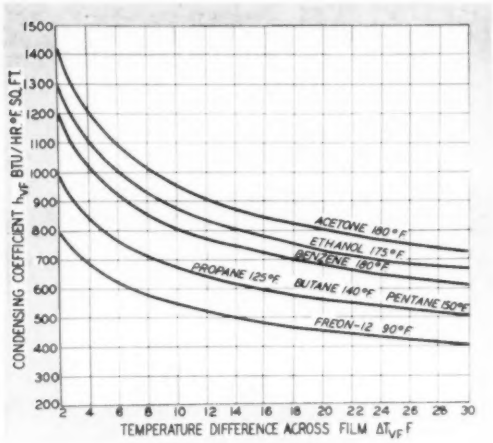
$$h = 0.725 \left(\frac{k^3 \rho^2 g \Delta H}{L \mu \Delta t_{vf}} \right)^{\frac{1}{4}} \qquad (1)$$

Vertical surface:

TABLE 1—DIMENSIONS OF LOW FINNED TUBES HAVING 16 FINS PER INCH

Nominal size (in.)	Dia. plain end (in.)	Dia. over Fin, D_o (in.)	Root dia., D_r (in.)	Wall thick. W (in.)	Area of fins (sq. ft./ft.)	Area equivalent, sq. ft./ft. $\phi = 1.0$	$\phi = .85$	$\phi = .70$	Diameter equivalent, D_{eq}, ft.* $\phi = 1.0$	$\phi = .85$	$\phi = .70$	Area outside A_o / Area inside A_i	Area finned tube / Area plain tube Same end diameter
$\frac{3}{8}$	0.500	0.494	0.374	0.032	0.218	0.316	0.283	0.251	0.0078	0.0083	0.0091	3.89	2.41
$\frac{1}{2}$	0.625	0.619	0.499	0.035	0.281	0.412	0.370	0.328	0.0089	0.0095	0.0106	3.67	2.51
$\frac{5}{8}$	0.750	0.744	0.624	0.042	0.345	0.508	0.457	0.405	0.0097	0.104	0.116	3.59	2.59
				0.047								3.65	
				0.065								3.92	
$\frac{3}{4}$	0.875	0.869	0.749	0.049	0.408	0.604	0.543	0.482	0.0102	0.0110	0.0120	3.54	2.63
Admiralty only $\frac{5}{8}$	0.750	0.742	0.640	0.065	0.300	0.467	0.422	0.377	0.0091	0.0100	0.0110	3.48	2.37

*To be used in Equation 3 for computation of condensing coefficient.



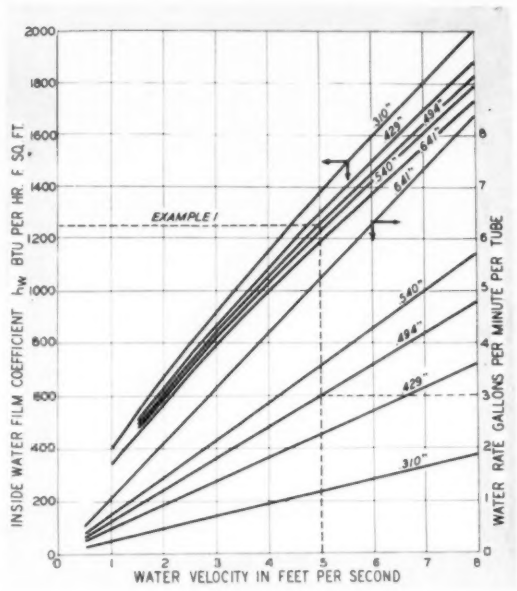


Fig. 2—(Above) Condensing coefficients on single horizontal tube with 16 fins per inch. Fig. 3—(Right) Calculated water film coefficient inside tubes at 105° F. average water temperature

$$h = 0.943 \left(\frac{k^3 \rho^2 g \lambda H}{L \mu \Delta t_{vf}} \right)^{1/4} \quad (2)$$

A combination of these Nusselt equations may be made to give an equivalent diameter for the horizonal tube equation as follows:

$$\frac{1}{D_{eq}^{1/4}} = \frac{0.943}{0.725} \frac{\phi A_f}{A_{eq} L^{1/4}} + \frac{A_t}{A_{eq} D_t^{1/4}} \quad (3)$$

Table 1 lists the equivalent diameters to be used in place of D with Equation 1 for indicated fin efficiencies. Fig. 2 gives condensing coefficients for a group of fluids, several of which were tested experimentally.[2,4,5] The coefficients are given for nominal $\frac{5}{8}$-in. finned tubes and for the saturation temperature given on the curve. Variation of the tube diameter or saturation temperature over the usual range will change these coefficients less than 5 per cent in most cases.

Effect of a number of tubes in a vertical row (n) is to lower the average coefficient because of the added thickness of the liquid film. Nusselt's derivation assuming viscous flow gives the relationship:

$$h \text{ (multitube)} = \frac{h^*}{n^{1/4}} \quad (4)$$

*Single tube

where n is the number of tubes in a vertical row.

The laboratory data indicate that the use of this relationship gives conservative coefficients.[2,5] The formulas suggested for finding the value of n for exchangers having more than 20 tubes are:

$$n = 0.815 \times X^{1/2} \text{ for square pitch} \quad (5)$$

$$n = 0.40 \times X^{1/2} \text{ for triangular pitch} \quad (6)$$

where X = total number of tubes in a unit on the vapor side.

Over-all coefficients for condensing vapors on the outside of banks of finned tubes may be computed from the usual equation.[6]

$$U_o = \frac{1}{\frac{1}{h_o} + r_o + \frac{L_m A_{ro}}{k A_m} + r_i \frac{A_{ro}}{A_i} + \frac{A_{ro}}{A_i h_i}} \quad (7)$$

The heat transfer becomes a product of the coefficient (U_o), the equivalent area of the finned tube (actual outside area discounted for fin efficiency) and the temperature difference. For convenience, the inside coefficients when using water are given on Fig. 3, based on Equation 4c, page 168, of McAdams[7] for smooth tubes. There may be a slight ripple on the inside of the finned tube which might increase the water film coefficient by an estimated 5 to 10 per cent over the values given on Fig. 3.

Fluid Convection

The computation of convection coefficients for the outside surface of finned tubes in exchangers is similar to that for plain tubes. For conditions of 96 to 100 per cent fin efficiency, the finned surface may be expected to be as effective per unit area as plain tube surfaces. This statement is based on a comparison between heating of air by tube banks,[1] performance of a multitube oil cooler,[1] and transfer from fluid in an annulus surrounding single tubes.[1]

Armstrong's data[1] on an exchanger containing 19 finned tubes 6 ft. long have been used to verify the equivalence of the finned surface to plain surface. The method presented by Short[8] was used to obtain the shell-wide coefficients corresponding to the baffles used. For half-moon baffles, the convection coefficient is given by Short as follows:

$$\frac{hD_e}{k} = 1.28 \left[\left(\frac{P - D_o}{P} \right) D_i \right]^{1/3} \left(\frac{c\mu}{k} \right)^{1/3} \left(\frac{D_e G_s}{\mu} \right)^{2/3} \quad (8)$$

This equation is for film coefficients outside of plain tubes. From the dimensions given by Armstrong for the

TABLE 2
Comparison of Armstrong's Data[1] with Calculated Coefficients by Short's Formula[8]

Average oil velocity shell side (ft. per sec.)	Shell side coefficient, B.t.u. per hr.-°F.-sq. ft. outside: Reported by Armstrong	Calculated by Eq. 8 from Short
0.49	28	41
0.92	55	63
1.23	77.5	77.5
1.53	100	92

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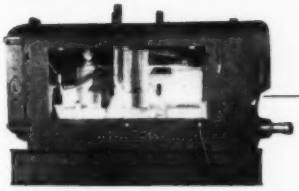
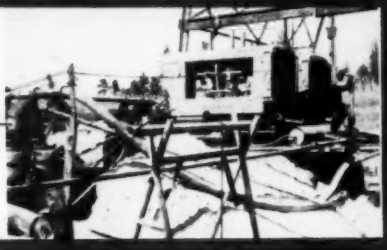
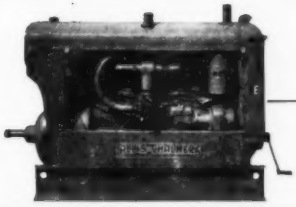
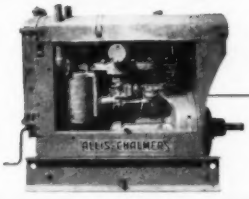


A-C Model L844
6 cyls. 5¼" x 6½"
844 cu. in. disp.
110 bhp at 1050 rpm
Torque 590 ft. lbs. at 700 rpm



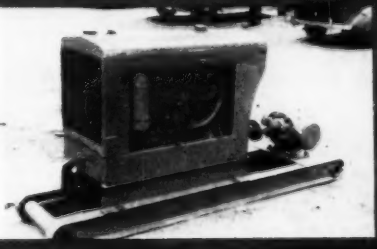


A-C Model E563
4 cyls. 5¼" x 6½"
563 cu. in. disp.
74 bhp at 1050 rpm
Torque 400 ft. lbs. at 700 rpm



A-C Model U318
4 cyls. 4½" x 5"
318 cu. in. disp.
51 bhp at 1400 rpm
Torque 200 ft. lbs. at 900 rpm

A-C Model W201
4 cyls. 4" x 4"
201 cu. in. disp.
34 bhp at 1400 rpm
Torque 128 ft. lbs. at 1200 rpm



A-C Model B125
4 cyls. 3⅜" x 3½"
125 cu. in. disp.
25 bhp at 1500 rpm
Torque 87 ft. lbs. at 1100 rpm

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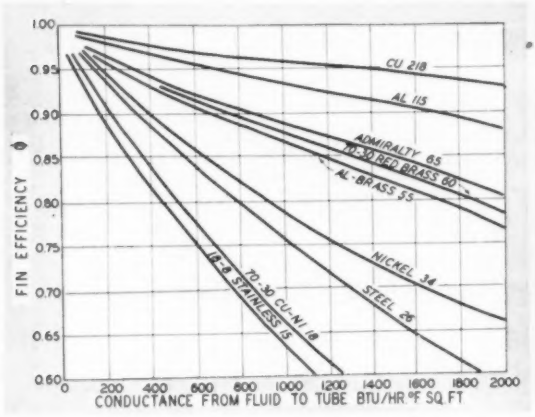

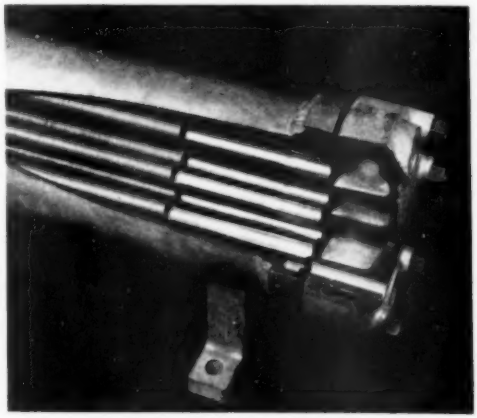

Fig. 4—(Left) Fin efficiency for tube with 16 fins per inch (fin height 0.062 in.). Fig. 5—(Right) Finned tube unit with cutaway section

exchanger, the film coefficient was computed assuming plain surfaces with a diameter equal to diameter over fins. Table 2 shows the comparison between Equation 8 and the experimental data computed on the basis of the outside finned area.

The experimental results, although limited, indicate that with Reynolds numbers above some minimum value (in this case 750) the finned surface may be used as prime surface. Further work is required to define the lower limit of velocity for this equivalence and the increase in coefficient which may be expected at high velocities. This comparison does not take into account differences in leakage through baffle holes or between tube bundle and shell[6] which might occur between plain and finned tubes.

Fin Efficiencies

The efficiency of fins is used to account for any temperature difference between the fin and the base metal. An efficiency of 0.5 indicates that one-half of the surface of the fins should be used as the transfer surface when using temperature differences between the fluid and the outside surface of the base metal. Gardner's paper[5] presents charts for predicting fin efficiency from the dimensions of the tube, thermal conductivity of the metal, and the outside film coefficient. In case of fouling, the total conductance between the fluid and fin surface should be used.

The fin efficiencies are given by Fig. 4 as a function of the outside coefficient or conductance for tubes shown in Table 1 having $\frac{5}{8}$-in. nominal diameter. This figure may be used for tubes at other diameters since the fin efficiency is only slightly affected by changes in diameter.

The effective outside area for a finned tube with a given design depends on the fin efficiency and may be computed as:

$$A_{r\phi} + A_r = A_{rf} \qquad (9)$$

Design of Condensers

Condenser design when using finned tubes is identical with that used for plain tubes excepting for the outside condensing coefficient and metal resistance. Fig. 5 is a shell-and-tube unit using the low finned tube. The condensing coefficients on finned surfaces and fin efficiencies of the previous section provide the data required. A design will be presented for an acetone condenser using the charts and a comparison will be made between the condenser size for condensing propane on plain and on finned tubes.

Acetone Condenser—Example 1

Compute the surface requirement for condensing 10,000 lb. of acetone per hour at 33.2 psia. (180° F. saturation temperature). Use 0.75 in. plain end (nominal $\frac{5}{8}$-in. root diameter), 0.065-in. wall thickness copper finned tubes. Cooling water is available at 85° F.

Solution.—Select a cooling water velocity of 5 ft. per second and a water exit temperature of 115° F. Use T.E.M.A. standards for fouling factors of 0.0015 inside and 0.0005 outside.

Heat balance.—Heat from condensing acetone $= 10{,}000 \times 205 = 2{,}050{,}000$ B.t.u. hr.

$$\text{Water required} = \frac{2{,}050{,}000}{30} = 68{,}300 \text{ lb. hr.}$$

68,300 lb. hr. = 8,200 gal. hr. or 137 g.p.m.

G.p.m. per tube at 5 ft. sec. from Fig. 3 is 3.03 g.p.m.

$$\text{Number of tubes per pass} = \frac{137}{3.03} = 45.2$$

$$\text{MTD} = \frac{(180 - 115) - (180 - 130)}{\ln (65 \div 50)} = 57.2$$

To obtain an approximation of the number of passes, assume an over-all coefficient (U_o) of 100.

$$\text{Approximate area} = \frac{2{,}050{,}000}{100 \times 57.2} = 358$$

sq. for outside surface.

Outside area of tubing per foot, Table 1 = 0.508 sq. ft. ft.

Approximate feet of tubing = 358 ÷ 0.508 = 705 ft.

Two passes would give 705 ÷ 90 = 7.8 ft. length for tubes.

The number of tubes in a vertical row (n) from Equation 5:

$$n = 0.815 \times 90^{\frac{1}{2}} = 8.46$$

$$n^{1.1} = 1.71$$

Assume fin efficiency is 1.00 and neglect metal resistance. Total resistance (R) except condensing vapor film is the sum of the outside fouling (r_o), the inside fouling corrected to outside area, and the water resistance (Fig. 3) corrected to outside area.

$$R = 0.0005 + [(A_o \div A_i) \times 0.0015] + (A_o \div A_i \times 1 \div h_w)$$

$$R = 0.0005 + (3.59 \times 0.0015) + 3.59 \div 1{,}250 = 0.0089 \text{ B.t.u. hr.} \cdot \text{F.-sq. ft.}$$

Try condensing film coefficient (h_{rf}) = 300.

$$1 \div h_{rf} = 0.00333$$

$$\Delta t_{rf} = 57.2 \times \frac{0.00333}{0.0089 + 0.00333} = 15.6° \text{ F.}$$

From Fig. 2 for single tube h_{rf} = 850 B.t.u. hr.-F.-sq. ft.

Correction for effect of tube bank is made by Equation 4:

h_{rf} n = 850 ÷ 1.71 = 497 B.t.u. hr.-F.-sq. ft. outside average condensing film coefficient for tube bank.

Try 560 for h_{rf} average:

$$\Delta t_{rf} = \frac{0.00185}{0.0089 + 0.00185} \times 57.2 = 11.1° \text{ F.}$$

Fig. 2 gives:

h_{rf} = 925 for a single tube.

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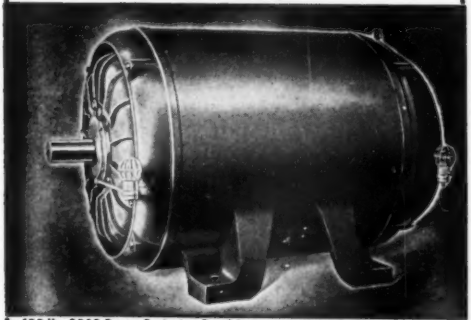

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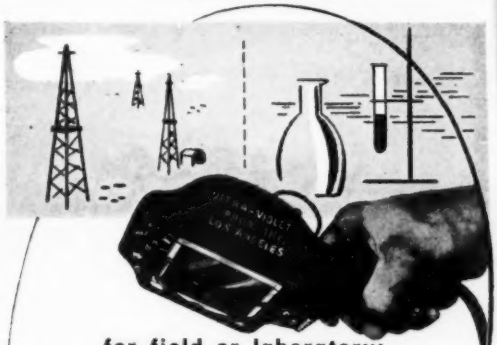

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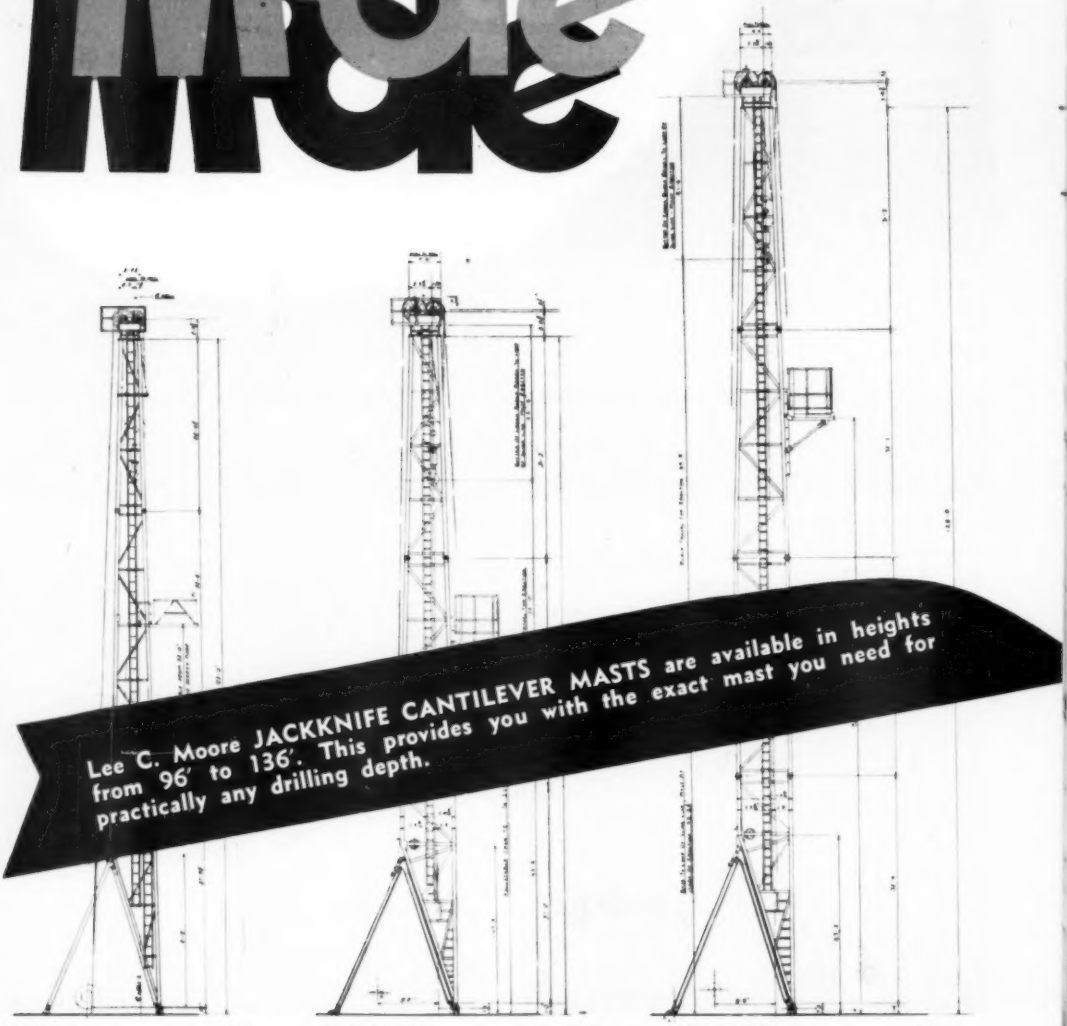

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No. of Sections	4
Crown Sheaves	1 - 36″ Dia.
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Racking Capacity of Platform Stands of 4½″ Drill Pipe	81 Doubles
Total Weight—Mast and Base	31,800 lbs.

Nominal Height	97 ft.
Nominal Capacity	480,000 lbs.
Width—Bottom end	15′ 0″
No. of Sections	4
Crown Sheaves	1 - 42″ Dia.
	3 - 36″ Dia.
Racking Capacity of Platform Stands of 4½″ Drill Pipe	110 Doubles
Total Weight—Mast and Base	49,639 lbs.

Nominal Height	128 ft.
Nominal Capacity	480,000 lbs.
Width—Bottom end	15′ 0″
No. of Sections	6
Crown Sheaves	1 - 42″ Dia.
	3 - 36″ Dia.
Racking Capacity of Platform Stands of 4½″ Drill Pipe	110 Trebles
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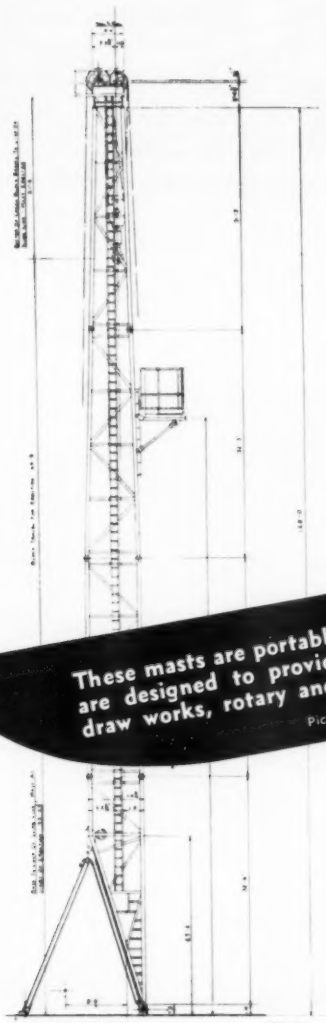

Nominal Height	128 ft.
Nominal Capacity	480,000 lbs.
Width—Bottom end	18' 5½"
No. of Sections	6
Crown Sheaves	1 - 42" Dia. 3 - 36" Dia.
Racking Capacity of Platform Stands of 4½" Drill Pipe	110 Trebles
Total Weight—Mast and Substructure	71,613 lbs.

by the addition or omission of a few parts.

Nominal Height	132 ft
Nominal Capacity	546,000 lbs.
Width—Bottom end	21' 0"
No. of Sections	7
Crown Sheaves	1 - 56" Dia. 4 - 36" Dia.
Racking Capacity of Platform Stands of 4½" Drill Pipe	148 Trebles
Total Weight—Mast and Substructure	87,371 lbs.

Nominal Height	140 ft.
Nominal Capacity	830,000 lbs.
Width—Bottom end	21' 0"
No. of Sections	7
Crown Sheaves	1 - 60" Dia. 5 - 42" Dia.
Racking Capacity of Platform Stands of 4½" Drill Pipe	148 Trebles
Total Weight—Mast and Substructure	101,699 lbs.

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960 1.71 = 560 B.t.u. hr.- F.-sq. ft. outside for multitube.

This value agrees with the assumption. A check on the fin efficiency by Fig. 4 shows that a vapor film + vapor side fouling conductance = $\frac{1}{1/560 + 0.0005} = 439$, the fin efficiency ($\phi$) from Fig. 4 = 0.97 which may be assumed equal to 1.0, or negligible.

$$U_o = \frac{1}{1/560 + 0.0089} = 93.8$$ over-all coefficient B.t.u. hr.- F.-sq. ft. outside.

$$\text{Area necessary} = \frac{2,050,000}{93.8 \times 57.2} = 382 \text{ sq. ft.}$$

Footage of tubing = 382 0.508 = 744 ft.

Length per pass = 744 90 = 8.36 ft.

Propane Condenser—Example 2

Compare the condenser size when using plain admiralty and finned admiralty tubes required to condense 100,000 lb. per hour of propane at 300 psia. and 150 F. Cooling water is available at 85 F.

Solution.—Assume that the condensing range is low enough so that the properties of pure propane may be used. Select tube sizes 0.75 in. o.d. plain end (5/8-in. nominal root diameter for finned tube)—admiralty. Select a water velocity of 6 ft. per second. Use T.E.M.A. standards for fouling factors of 0.002 inside and 0.001 outside. Water temperature out assumed 125 F.

Heat balance.—Condensing temperature = 138 F.

Heat transferred in cooling propane vapor to 138 F., 0.40 × 100,000 × 12 = 480,000 B.t.u. hr.

Heat transferred in condensing propane, 141 × 100,000 = 14,100,000 B.t.u. hr.

Total heat to cooling water = 14,580,000 B.t.u. hr.

Water required:

$$\frac{14,580,000}{40} = 365,000 \text{ lb. hr.}$$

$$\text{MTD} = \frac{53 - 13}{\ln (53/13)} = 28.3 \text{ F.}$$

Average water temperature = 138 — 28.3 = 109.7 F.

Number of tubes per pass when using 6 ft. sec.:

$$= \frac{365,000 \times 4 \times 144}{3,600 \times 62.4 \times \pi (0.510)^2 \times 6} = 194 \text{ tubes}$$

Estimate on over-all coefficient. U_o = 80 B.t.u. hr.- F.-sq. ft. outside.

$$\text{Total area necessary} = \frac{14,580,000}{80 \times 28.3} = 6,450 \text{ sq. ft.}$$

$$\text{Total length of tubing} = \frac{6,450}{0.467} = 13,800 \text{ ft.}$$

Using four passes water side:

$$\text{Length of tubes} = \frac{13,800}{4 \times 194} = 17.8 \text{ ft.}$$

(first approximation).

Total number of tubes = 4 × 194 = 776 tubes.

Estimated condensing film coefficient.—h_{vf} = 400 B.t.u. hr.- F.-sq. ft., average.

Total conductance, vapor side

$$= \frac{1}{1/400 + 0.001} = 286$$

From Fig. 4, the fin efficiency, ϕ = 0.955.

Effective area of finned tube per foot:

$$A_{vf} = \phi A_f + A_i = 0.300 \times 0.955 + 0.167 = 0.453 \text{ sq. ft. ft.}$$

Water film coefficient inside tubes, h_w.

$$h_w D_i / k = 0.023 (D_i V \rho / \mu)^{0.8} (C\mu / k)^{0.4}$$

$$h_w = \frac{0.023 \times 0.363^{0.8}}{0.0424} \left(\frac{0.0424 \times 6 \times 61.9}{0.617 \times 0.000672} \right)^{0.8} \left(\frac{0.998 \times 0.617 \times 2.42}{0.363} \right)^{0.4}$$

h = 1,510 B.t.u. hr.- F.-sq. ft. inside.

Condensing film coefficient.—Height of fin.

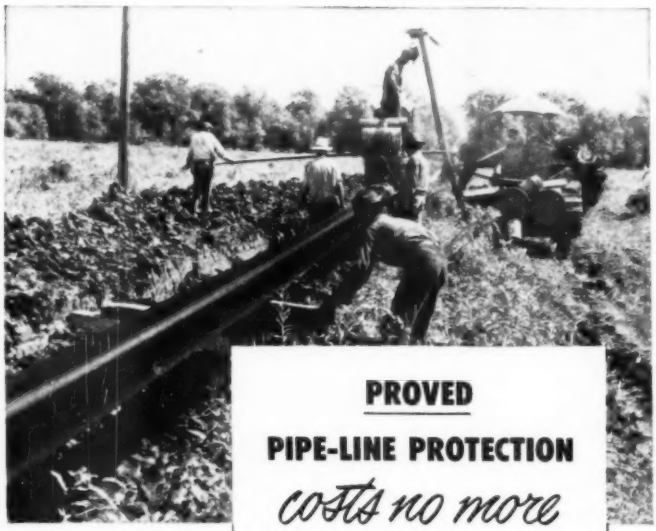
$$L = \frac{a_f}{D_o} = \frac{(0.742^2 - 0.640^2)\pi \cdot 4}{144 \times 0.742 \cdot 12} = 0.01245 \text{ ft.}$$

$$(1/D_{vf})^{0.5} = \frac{0.943}{0.725} \frac{0.935}{0.453} \times \frac{1}{(0.01245)^{0.5}} \frac{0.167}{0.453} \frac{1}{(0.0533)^{0.5}} \quad (3)$$

$$(1/D_{vf})^{0.5} = 3.23$$

$$D_{vf} = 0.0093 \text{ ft.}$$

For propane at 138 F.:



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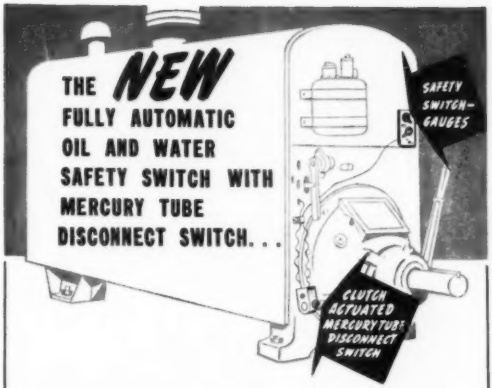

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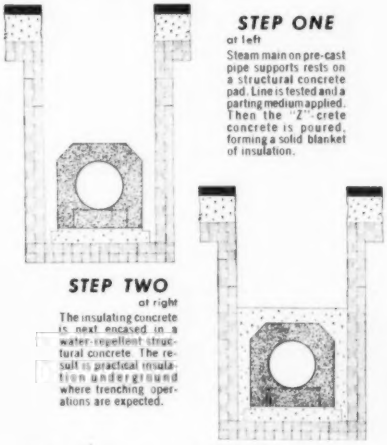

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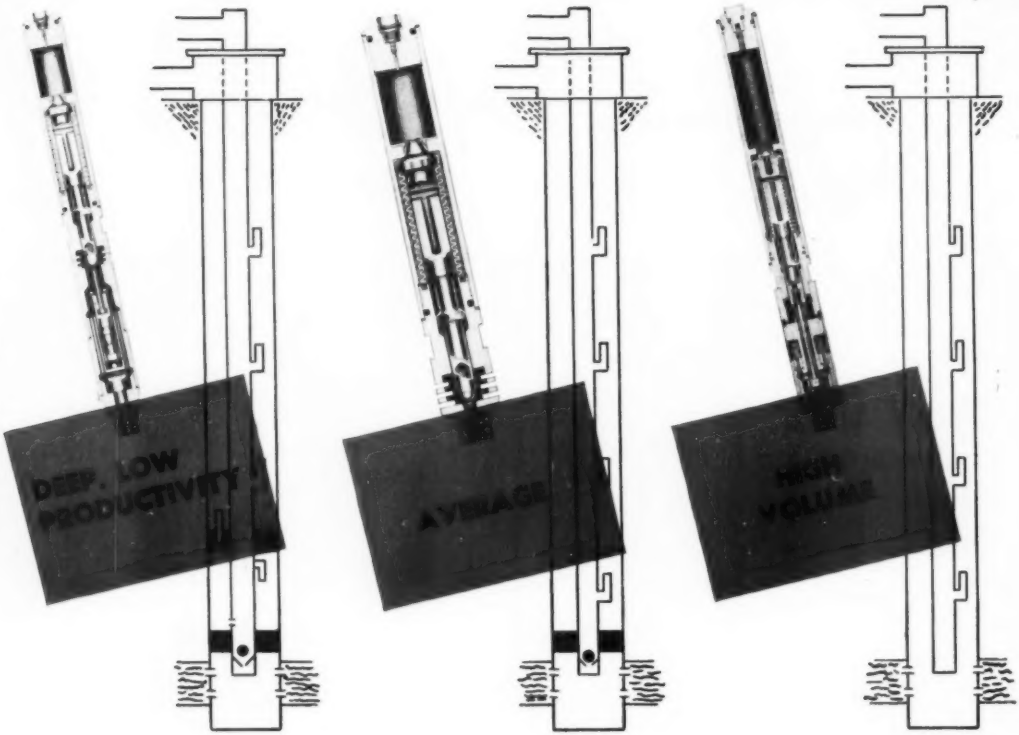

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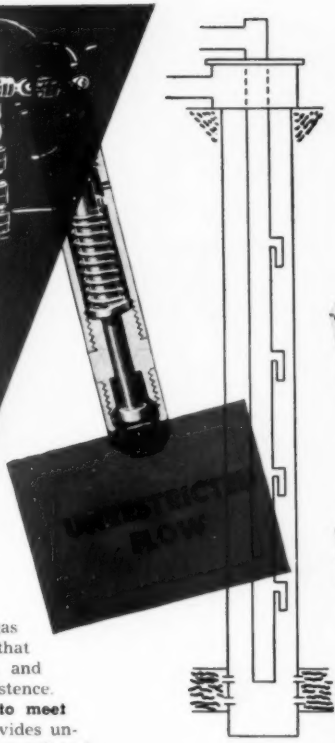

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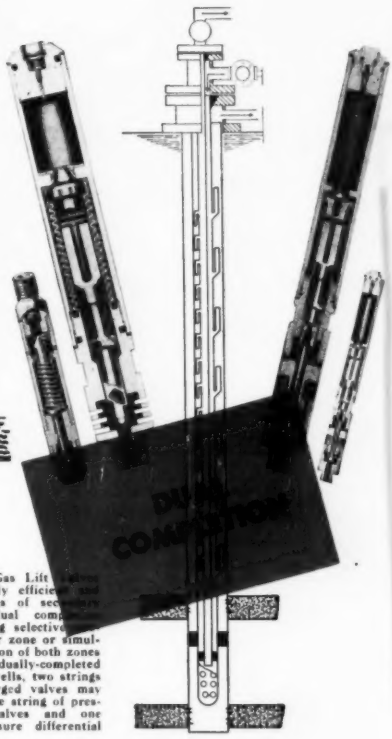

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$\rho = 26.3$ lb./cu. ft.

$$\cdot \left(\frac{0.453}{0.134} \quad \frac{1}{1.510}\right) \cdot \left[\frac{0.453}{0.134} \quad (0.002)\right]$$

$$h_{vf} = 0.725 \left(\frac{0.072^3 \times 26.3^2 \times 113 \times 417 \times 10^6}{0.075 \times 2.42 \times \Delta t_{vf} \times n \times 0.0093}\right)^{1/4} = \frac{1,230}{(\Delta t_{vf} n)^{1/4}} \quad (1)$$

$n = 0.815 \times (766)^{1/20} = 25.9$ (Eq. 5)
$n^{1/4} = 2.26$

$$h_{vf} = \frac{1,230}{2.26\,(\Delta t_{vf})^{1/4}} = \frac{545}{(\Delta t_{vf})^{1/4}}$$

Total resistance except vapor film:

$$= 0.001 + \left(\frac{0.453}{0.150} \times \frac{0.65\ 12}{65}\right)$$

$= 0.0103$ B.t.u./hr.-sq. ft.-° F.

Try an average condensation coefficient for tube bank:

$h_{vf} = 350$ B.t.u. hr.-° F.-sq. ft.

$$\Delta t_{vf} = 28.3 \times \frac{1\ 350}{0.0103 + 1\ 350} = 6.15° \text{ F. for vapor film}$$

$h_{vf} = 545\ (6.15)^{1/4} = 346$ B.t.u. hr.-° F.-sq. ft.

Try $h_{vf} = 345$ B.t.u./hr.-° F.-sq. ft.:
$\Delta t_{vf} = 6.21°$ F.
$h_{vf} = 545\ (6.21)^{1/4} = 345$ B.t.u./hr.-° F.-sq. ft. outside

$$U_o = \frac{1}{0.0103 + 1/345} = 75.8 \text{ B.t.u./hr.-° F.-sq. ft. outside.}$$

$$\text{Total area required} = \frac{14,580,000}{75.8 \times 28.3} = 6,800 \text{ sq. ft. outside.}$$

$$\text{Total tubing required} = \frac{6,800}{0.453} = 15,000 \text{ ft.}$$

Since the estimated fin efficiency $\phi = 0.955$ was based on $h_{vf} = 400$, the actual ϕ will be slightly higher making the tubing requirement very slightly less than calculated.

A similar calculation using plain ¾-in. admiralty tubes with the same water velocity shows that 27,500 ft. of plain tube would be required. The required amount of finned tubing would cost 73.5 per cent as much as the plain tubing. It is estimated that the total cost of the finned tube condenser would be 69 per cent of the cost of the condenser using plain tubes.

The significant items in comparing the relative footage of plain and finned tubes are water velocity, inside fouling factor, and outside fouling factor. An increase in water velocity will cause a greater decrease in the finned tube requirement than in the plain tube requirement. An increase in inside fouling factor will increase the finned tube requirement more than the plain tube while the reverse is true when increasing the fouling on the outside.

Whenever the outside coefficient is decreased such as by the presence of "non-condensables" in the vapor to a condenser, the use of finned tubes becomes more advantageous.

Design of Exchangers

Procedure for designing exchangers containing low finned tubes is essentially the same as for plain tubes. It is expected that the effect of baffles is generally the same for finned tubes as for plain tubes. Use of the greater area on the outside of the tubes will result in lower tube requirement depending upon the conditions. Although more fouling may take place with finned tubes than with plain tubes in some services, successful commercial use with quench oil has been reported.[3] Designs will be presented for an oil exchanger and an air cooler.

Oil Exchanger—Example 3

It is desired to cool a clear wax distillate by exchanging heat with a cold crude.

Entering streams:

5,000 bbl. per day of 35° A.P.I. crude at 160° F.

1,750 bbl. per day of 30° A.P.I. wax distillate at 480° F.

Desired final temperature at wax distillate = 240° F.

The exchanger will be designed with an average velocity of 2 ft. per second shell side and 4 ft. per second tube side, wax distillate tube side.

Fouling factors from T.E.M.A.[2] shell side 0.003, tube side 0.002.

Use nominal ¾-in. tube, ⅞-in. ends.

(Continued on page 335)

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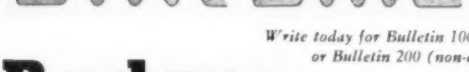

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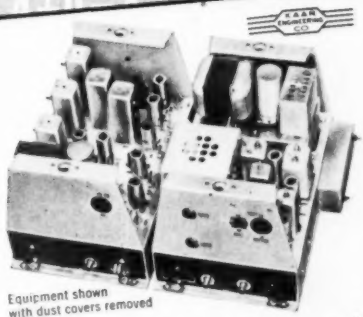

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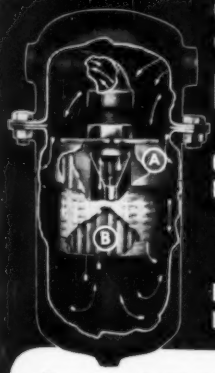

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Oil Losses

ELIMINATION AND CONTROL

From the time crude petroleum leaves the well until the products of the crude are usefully consumed, losses are taking their toll. It has been estimated that of every 100 gal. of crude removed from the ground, only 97 gal. contribute to the nation's well being, the other 3 being lost in storing, transporting, and refining the crude and in storing, transporting, and marketing the products. The application of improved conservation measures in handling the nation's aboveground petroleum resources can, over the years, result in making available to consumers an additional amount of oil equal to the discovery of a sizable new field.

The introductory material on this page was prepared by the Committee on Oil Loss Prevention, Esso Standard Oil Co. This same working committee of Esso Standard also prepared two articles which follow immediately, entitled "Loss Control in Petroleum Refineries" and "Control of Product Stock Losses in Storage and Loading."

IMPORTANCE of oil-loss prevention has been recognized by the industry for a long time. Witness the number of articles published in the trade press on evaporation losses and the rapid strides made by the tank manufacturers in improving conservation devices. Unfortunately, most of the industry leave details of these technical matters in the hands of advisory and staff groups with the result that the operating forces are not fully informed on the latest procedures and equipment to reduce losses. Further, in a company such as Esso Standard Oil Co., the coordination of the transportation, manufacturing, distribution, and marketing operations was not extended into the loss-control activities since they were considered merely as a part of the operating management's responsibility.

About 10 years ago, the first steps were taken to establish means for the exchange of technical and operational know-how on loss control through a coordinated oil - loss - prevention program. It is the purpose of this and succeeding papers in this series to review the evolution of this oil loss control system in the Esso Standard Oil Co.

First step in any loss-control program is the accurate measurement of all quantities. On first glance, this would appear to be relatively simple to accomplish and it would be if the art of measuring petroleum were not in its infancy. In actual fact, the measurement of bulk petroleum has not kept pace with the technological advances in the other phases of the industry, with the result that many of our techniques and much of our equipment are reminiscent of the days of batch stills and horse-drawn tank wagons. Some improvements have been made, but much has yet to be accomplished in this field, and subsequent articles will describe the activities in this phase of the program.

After the receipts, inventories, and deliveries are correctly measured, the next step is to determine the loss. In many operations, where no change in state or density of the crude or products occurs, the loss is represented by the difference between receipts and deliveries plus or minus the inventory change, all volumes being corrected to a common temperature for direct comparison. However, in a modern refinery, the problem is much more complex and considerable time has been devoted to the development of a practical means of determining the magnitude of refinery losses.

Once the losses are determined accurately, the analysis, elimination or reduction, and control can go forward in a logical, intelligent manner. Also, since evaporation plays an important role in the over-all program and is a subject of interest to all of the operating units, subsequent material will cover the technical aspects of this phase of the over-all activity.

In other words, oil-loss control is a broad field encompassing all of the major functions in an integrated company. Intelligent planning and coordination of the operating, accounting, and engineering activities in this field require a ready means for the interchange of knowledge and the integration of the individual departmental problems into the company-wide picture. This is accomplished in Esso Standard Oil through the "committee on oil prevention." This organization serves as a clearing house for all information on oil loss prevention and allied matters. In addition, the committee staff, headed by a full-time oil-loss-prevention coordinator, serves the operating departments.

The oil-loss-control program in Esso Standard is the result of the evolution of ideas on control techniques and procedures over the past 20 years. Experience gained during this period has proved that, in order to insure effectiveness, the program must be coordinated on a company-wide basis, and that the first step is the accurate determination of the magnitude of the loss. Accurate determination of the loss provides a measure of the economic incentive to go forward with engineering and development work to reduce or eliminate loss sources. The initial impetus of the program must come from informed management. Its ultimate success depends upon the proper training of the field operating people in the application of established control procedures in their daily operations.

LOSS CONTROL

IN PETROLEUM REFINERIES*

THE program of refinery loss control as followed in the Esso refinery ss-control program consists of three principal phases: (1) Determination of the magnitude of the total loss; (2) isolation of all loss sources and the development of means of elimination or reduction of the losses; and (3) application of a system to control the losses within reasonable limits.

1. Determination of total loss. — Knowledge of the magnitude of the total loss for a given plant is a prerequisite for an intelligent analysis of the individual losses. In this program, the total loss is considered to be composed of four major divisions: Transportation, terminaling, crude storage, and manufacturing.

Conservation activities begin at the time the crude and other process stocks are purchased. Since, in most cases, the refinery is billed for the quantity of purchased material at the shipping point, any losses incurred in transporting these process stocks are chargeable to the refinery. As a control measure, these are reported according to the type of carrier involved. While beyond the scope of the refinery loss-control program, any unusual losses are referred to the appropriate department for action.

Once the process charge stocks are received into the refinery, there begins the big job of accurately accounting for all stock movements. The first step is the crude-storage account, i.e., the tanks set aside for receiving and building up inventories of charge stocks. Accurate data are maintained

on the movements through each tank so that the individual losses can be readily determined. When totaled, these represent the loss for the crude-storage account.

At the same time a refinery receives, stores, and ships materials which do not become mixed with the regular production. Losses of such segregated terminaled stocks are reported as another item. While these losses do not result in decreased yields for a given unit of charge stock, experience has shown the desirability of including them as a part of the total loss.

Use of common lines for the transfer of stocks within the refinery provides many opportunities for open valves, incorrect line displacements, etc., which often lead to erroneous accounting of transfers. Information on the terminaling operations thereby provides another tool for reconciling indicated overages or shortages in a particular account. Also, accurate information on the handling losses permits equitable charges to be established for the terminaling operations. All of these losses are obtained by direct measurement and are shown separately for naphthas, middle distillates, and residuals.

2. Isolate loss sources. — Second phase of the program—the isolation and evaluation of the individual loss sources comprising the total plant loss—serves a dual purpose. The total of the individual losses is used first to indicate the reasonableness of the calculated loss and, second, to measure the progress of the field investigations of the individual loss sources. The necessity for maintaining a vigorous program in the field to isolate and evaluate the individual loss sources cannot be overemphasized. This is the means by which the loss-control activities are first concentrated on the most important sources and methods devised to reduce or eliminate these losses. At the start of this program, some of the Esso plants could account for only about 20 per cent of the loss. Now, however, some of these same plants can account for all but about 20 per cent of the loss.

Some of the typical loss sources identified in the refineries are shown in Table 1.

TABLE 1—TYPICAL LOSS SOURCES IN A REFINERY

1. Gas burned at flares
2. H_2S burned
3. Evaporation from naphtha tanks
4. Evaporation from separator surfaces
5. Oil in effluent streams from separators
6. Doctor regeneration
7. Mercaptans, phenols, naphthenic acids, and H_2S removed in soda washing
8. Leaking valves, lines, pumps, etc. (materials not later collected in separator)
9. Gasoline blending
10. Overfilling motor-oil cans
11. Loading tank cars and tank trucks
12. Cleaning tanks

3. Application of control system.— Once a particular loss has been firmly

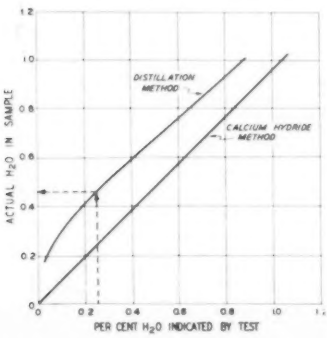


Fig. 1—Relationship between actual and apparent water content

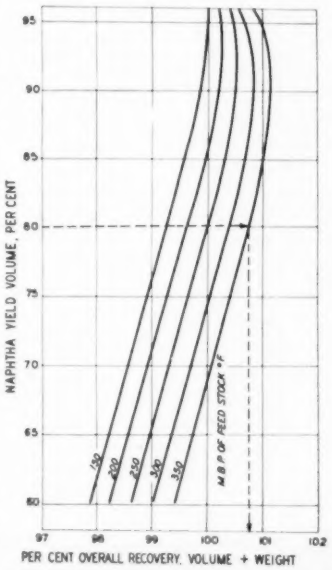
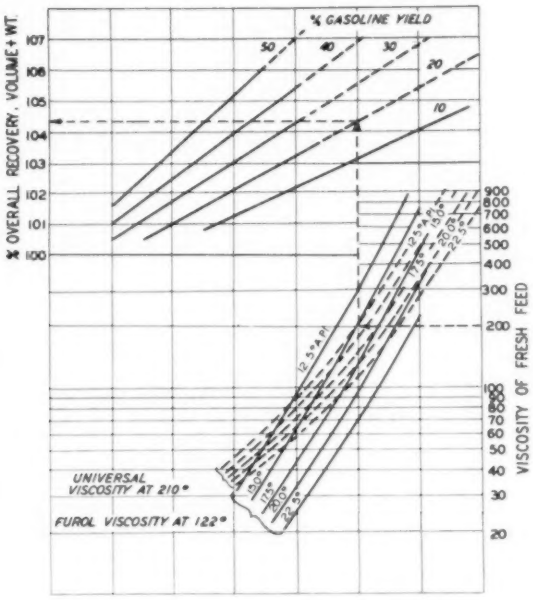


Fig. 2—Plot of recovery on cracking naphthas vs. naphtha yield and midboiling point of feed

*Material by Committee on Oil Loss Prevention, Esso Standard Oil Co.



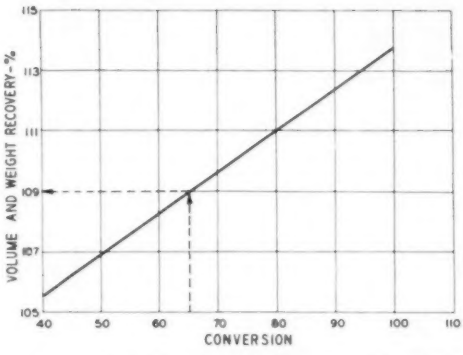


Fig. 3—(Left) Prediction of over-all volume plus weight recovery when cracking reduced crudes. Fig. 4—(Above) Total recovery on catalytic cracking

evaluated, there begins the study of methods of reducing or eliminating the loss. Economic considerations are an integral part of these studies. As a general rule, a lower rate of return on the estimated investment is justified for conservation measures than is customary for process changes and the like. When the solution of a particular problem has been agreed upon, every effort is made to expedite the control measures selected.

Proper control of losses is dependent upon, among other factors, frequent and regular checks on the losses. The shorter the control period the better, but the length of the period will be governed by certain practical limitations. In the Esso program, approximate manufacturing losses are reported monthly for the information of the local management and to indicate the trend. These losses are obtained by calculating only the major corrections to the "anticipated recovery." Up to this time, monthly control has proved fairly satisfactory. All corrections are made, however, semi-annually in a comprehensive "analysis of refinery losses," and these reports are used to measure the progress of the entire program.

Concurrent with the control measures designed to provide accurate basic data for calculating the losses, are the steps taken to insure that the plant operations are closely supervised from a conservation standpoint. While much of this work depends upon education of the personnel, which will be discussed later, there are many things that can and should be done to secure good control of the operations.

Naphtha Evaporation Losses

Evaporation losses from naphtha tankage have been found to be a major loss source at some of the plants, particularly at larger plants having extensive tankage facilities. Any attempts at reducing tankage evaporation losses through tank rehabilitation must be preceded by knowledge of the condition of the tanks. This information, together with data on the service and working condition of the tanks, is used to calculate the loss for each tank.

During the early days of the program, it was found that some tanks were permitted to stand idle with excessive outages for long periods of time. In other instances, nonvolatile stocks were stored in tanks designed for storing volatile products, and vice versa.

Losses of segregated terminaled stocks are obtained by direct measurement. In many instances, however, refineries receive for terminaling finished products which are commingled with the refinery production. Since these operations increase the manufacturing losses and no direct

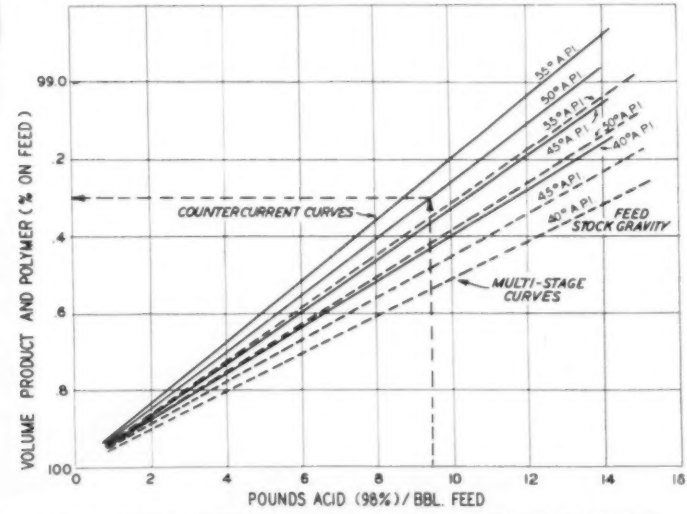


Fig. 5—Over-all volumetric recovery on acid treating cracked naphtha distillates

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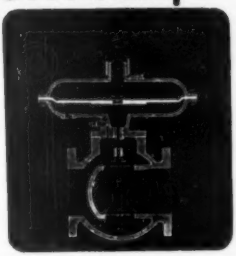

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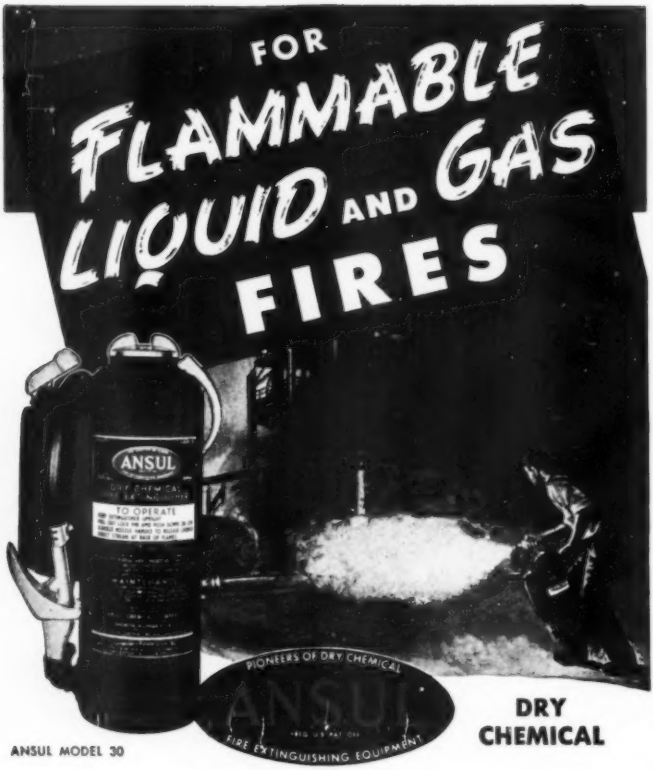

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measurement can be obtained, it is necessary for the plants to have some means of estimating the magnitude of the loss.

To eliminate estimating variations and to provide further standardization of the calculation procedure, "loss allowances" were prepared for use by all the Esso plants. These were made sufficiently flexible to compensate for the difference in the actual operating procedures among the plants. The use of these allowances affords a means of isolating terminaling losses from those attributable to the manufacturing operations.

Surprisingly large losses can be experienced in the slop oil and waste-handling operations. While a certain amount of slop production must be expected in refinery operations, control measures should be provided to aid in preventing excessive losses and product degradation resulting from carelessness and inefficiency in the operations. Some of the plants are making considerable progress in the activities directed toward reducing the daily slop production. Periodic reviews of the waste-disposal procedures at the various plants aid in determining the most efficient disposal procedures for particular types of slops.

Another factor contributing to a reduction in losses as well as aiding in preventive maintenance has been the use of pump checkers. Equipped with a stop watch and an ordinary graduated cylinder from the laboratory, these men check the liquid leakage from all pumps within the refinery and submit daily reports on each pump checked. Tightening the packing on a pump often can stop a costly

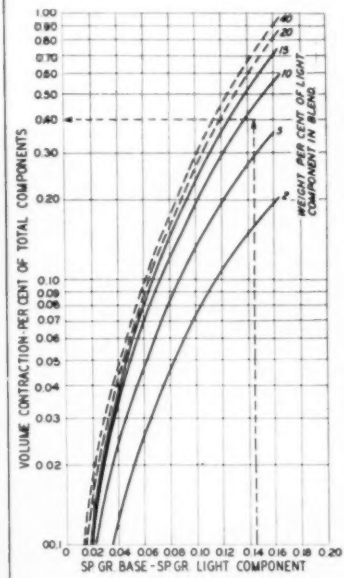

Fig. 6—Volume contraction on blending

leak. At other times, prompt attention may save a pump from serious damage. In some areas the loss from leaking pumps has been reduced by as much as 50-75 per cent by these regular surveys.

Operation of the waste-water separators usually comes under the supervision of the plant's oil-conservation department. In this connection, evaporation losses from separator surfaces have been found to represent a significant portion of the loss at some of the plants. Considerable progress has been made in reducing these losses. For example, test data have shown the following factors to affect the losses from separator surfaces:

1. Volatility of oil entering the separator.
2. Exposure time.
3. Surface area exposed.

As a result, efforts have been directed along lines tending to minimize the possibilities of such losses. It is customary to utilize self-adjusting skimmers at the inlet box or flume to separators to recover the maximum amount of easily separable oil as soon as possible.

While the measures referred to represent only a part of the total control exercised, the success of any control lies in the continuity and followup provided. Real progress requires having men out in the plant constantly working toward reduced losses and the isolation of new loss sources.

Loss Goals

With the attainment of representative loss goals, the next step toward accurate control of losses is the establishment of standard losses. These represent the point at which it is uneconomical to spend additional money to effect further reductions in the losses. At the same time, any loss in excess of the standard would indicate retrogression in the control program. Such tools as these enable the refiner to measure the actual performance for a given control period.

The success of such an all-inclusive program depends upon teamwork and cooperation. The design groups constantly must be alert to the possibilities of designing equipment which will tend to minimize losses. The maintenance forces must exert every effort to keep the equipment in good physical condition.

It has been found that the program progresses more rapidly when the local problems are left to the particular plants, with the long-range projects referred to central engineering groups for development and subsequent application. In this way, the personnel assigned to the conservation program can concentrate on specific problems considered to be of prime importance.

Calculation Procedure—Manufacturing Operations

When considering the complex operations conducted in today's refinery, the apparent loss indicated by most yield statements bears no resemblance whatsoever to the real plant loss. Operations such as cracking, alkylation, polymerization, hydrogenation, isomerization, etc., give volumetric recoveries more or less than 100 per cent, depending upon the particular operation. This necessitates the use of some method which will fairly represent actual conditions.

Before describing the loss-calculation procedure in use at the Esso plants, a few comments on the yield accounting system may help to clarify some later details. In reporting yields, all liquid products (C_4 and heavier) are reported by volume, whereas gases (C_3 and lighter) and solid products such as coke, wax, petrolatum, and grease are shown on a weight basis. This means that all liquids are reported as C_3-free while gases are reported as C_4 free. The total production, volume plus weight, reported on the yield statements is not adjusted to compensate for contraction and expansion, but represents the actual recovery for the accounting period.

The calculation procedure which has been in use throughout this program was designed to utilize the re-

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finery yield statements to the maximum possible extent by making necessary compensations for the state and density changes in the processing operations. Correlations were developed to evaluate the effect of all major variables on the total recovery for each process. These correlations show an "anticipated recovery" which corrects for the effect of changes in the operations on the volume (liquid products) and weight (gases and solid products) yield.

Several changes in the regular yield accounting procedures were required to insure a common basis of calculation and to permit a direct comparison between the total refinery recovery as shown on the refinery yield statement and the calculated anticipated recovery. The difference between these two values is representative of the true manufacturing loss.

The correlations used for calculating the "anticipated recovery" were based on plant tests which had shown 100 per cent weight yields (no loss). It was felt that the volume-plus-weight method was a reasonable substitute for the weight method since several checks between the losses determined by these two methods gave good agreement.

The anticipated recovery is calculated for a total divisor which includes all crudes and purchased unfinished stocks (gas oil, casinghead, etc.) which are handled through one or more processing steps in the refinery. Also included are all slop oils and waste products brought into the refinery. Such materials as tetraethyl lead, dyes, inhibitors, etc., are not included as a part of the total divisor since they constitute only a small fraction of the total production. Table 2 shows a sample classification of the stocks in the total divisor.

TABLE 2—MAKEUP OF TOTAL DIVISOR

Crude oil processed (H_2O free), bbl.	80
Unfinished stocks processed (H_2O free) bbl.:	
1. Butane (extraneous)	
2. Slop from outside sources	
3. Naphtha	20
4. Middle distillates	
5. Residuals	
Total divisor (H_2O free), bbl.	100

It will be noted that the stocks comprising the total divisor are shown on a water-free basis, but that suspended sediment is included as part of the total charge. This procedure is justified on the basis that sediment present in the charge stocks eventually appears in the total production as coke or in the fuel oil residual allowance.

Distillations of each of the various charge stocks indicate the amount of water present. By means of the correlation shown in Fig. 1 the water content indicated by the distillation is converted to the actual water content. In the case of light stocks, the

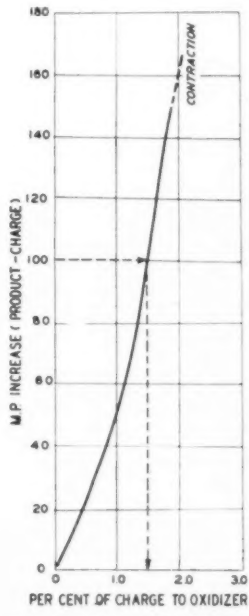

Fig. 7—Over-all volumetric reduction on oxidation of asphalts

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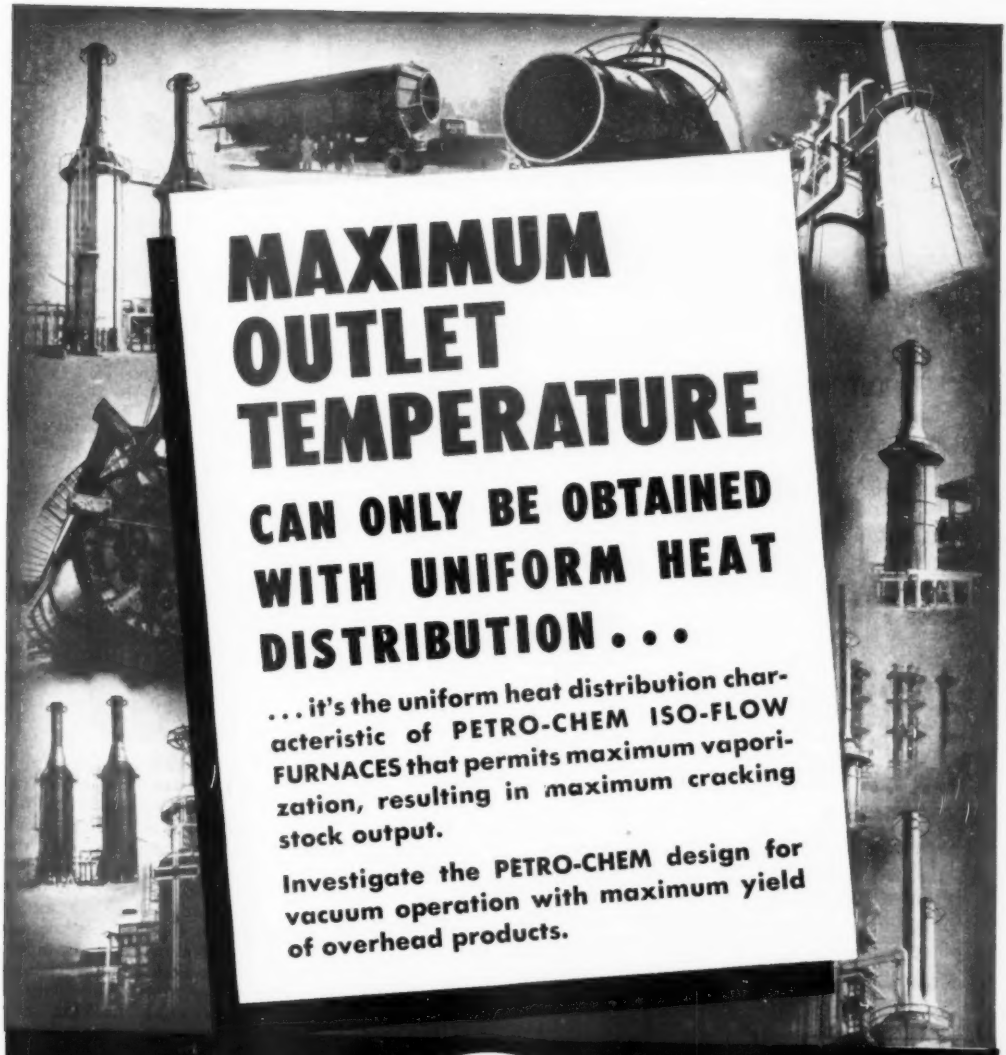

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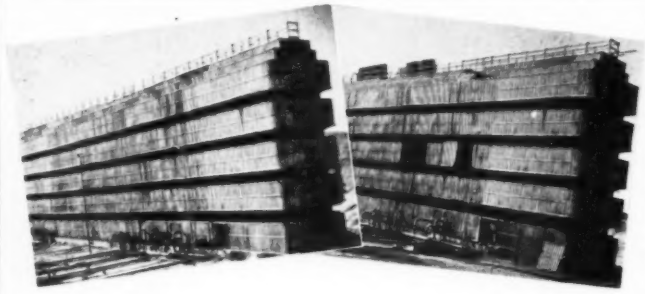

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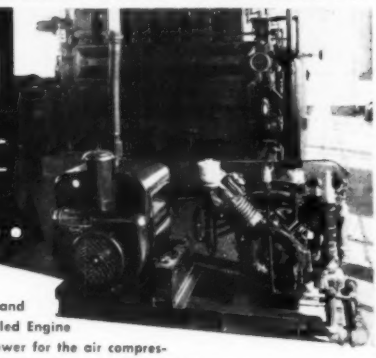

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indicated water content is determined by a procedure involving the use of calcium hydride, with the actual content also determined from Fig. 1.

Once the total divisor has been determined, it is then necessary to calculate the "corrections" involved in the "anticipated recovery." As part of an illustrative example of the "anticipated recovery" procedure for the calculation of losses in the manufacturing operations (Table 3), the following "corrections" will be developed by means of the indicated correlations developed for this purpose:

1. Naphtha reforming.
2. Reduced crude cracking.
3. Catalytic cracking.
4. Gas in crude.
5. C_3 and lighter as liquid.
6. C_4 and heavier as gas.
7. Acid treating naphtha.
8. Gasoline blending.
9. Asphalt oxidation.
10. Difference in feed-stock gravity.

The mathematical result of each "correction" is given in Table 3.

It will be noted in Table 3 that anticipated recovery (uncorrected) = 100.0 per cent, is shown following the total divisor. This shows the quantity of material, expressed as per cent of the divisor, that would be recovered if no loss or change in volume or physical state occurred during the processing operations.

TABLE 3—CALCULATION OF MANUFACTURING LOSS BY "ANTICIPATED RECOVERY" PROCEDURE

Anticipated recovery (uncorrected), per cent	100.00
Corrections—% on total divisor:	
1. Naphtha reforming (thermal)	+0.08
2. Reduced crude cracking (thermal)	+1.29
3. Catalytic cracking	+1.80
4. Gas in crude	—0.79
5. C_3 and lighter as liquid	+0.88
6. C_4 and heavier as gas	—0.21
7. Acid treating naphthas	—0.28
8. Gasoline blending	—0.08
9. Asphalt oxidation	—0.15
10. Difference in feed-stock gravity	—0.19
Total corrections—%	+2.35
Anticipated recovery (corrected)—%	102.35
Actual recovery (vol. % + wt. %)	101.15
Plant loss—%	1.20
Plant loss—bbl.	1.20
Loss in terminaling commingled stocks, bbl.	0.20
Manufacturing loss—% on total divisor	1.00

1. Naphtha reforming.—Fig. 2 shows the correlation used to predict the recovery (volume + weight per cent) for naphtha-reforming operations. The following example will serve to illustrate:

Total divisor = 100 bbl.
Fresh feed to reforming = 10 bbl.
Mid-boiling point of fresh feed = 350° F.
Naphtha yield = 80 per cent.
Predicted recovery (from Fig. 2) = 100.75 per cent.

Correction = (10/100) (100.75 — 100)
= +0.08 per cent

2. Reduced crude cracking. — The correlation for predicting the recovery when thermally cracking reduced crudes is shown in Fig. 3. Here assume the following conditions:

Total divisor = 100 bbl.
Fresh feed to cracking = 30 bbl.
Viscosity of fresh feed = 200 Furol at 122° F.
Gravity of fresh feed = 15° A.P.I.
Naphtha yield = 20 per cent.
Predicted recovery (from Fig. 3) = 104.3 per cent.

(Correction = (30/100) (104.3 — 100.0)
= +1.29 per cent

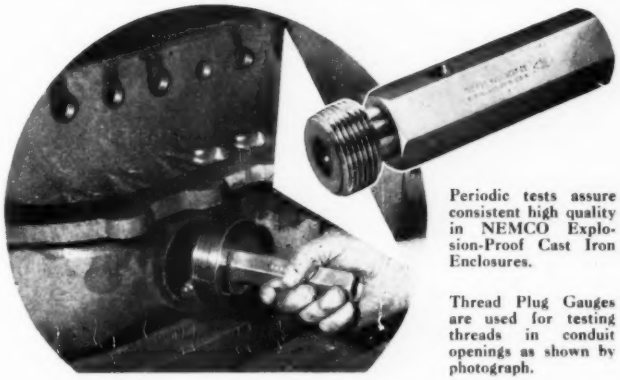
3. Catalytic cracking.—For catalytic cracking operations, Fig. 4 is used to predict the total recovery.

Total divisor = 100 bbl.
Fresh feed to cracking = 20 bbl.
Conversion = 65.0 per cent.
Predicted recovery (from Fig. 4) = 109.0 per cent.

Correction = (20/100) (109.0 — 100.0)
= +1.80 per cent

In case a material previously considered as a gas yield is later disposed of as a liquid, or converted in another process to a liquid product, it is necessary to correct the anticipated recovery for this change. The same applies in case a liquid is later converted to a gas. The next three corrections should help to clarify this point.

4. Gas in crude.—Since there is a certain quantity of gas in crude oil, this quantity is measured by volume



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in the receipts and charge stocks. The calculation procedure, however, is based on the fact that gas production, in addition to wax and coke, is shown as a weight yield. In order to convert the gas in the crude (going to pipe stills) from a volume to a weight yield, another "correction" is applied, as shown by the following example:

Total divisor = 100 bbl.

Crude charge to pipe stills = 80 bbl.

Gas in crude = 2 per cent (from true-boiling-point workup).

Specific gravity of crude charge = 0.85.

Note.—It is essential that the true-boiling-point yield of gas should represent C_1-free gas and C_5-free liquid products.

$$\text{Correction} = 100\left(\frac{2}{100}\times\frac{80}{100}\times\frac{151.2}{349.9\times 0.85}\right) - \left(\frac{2}{100}\times\frac{80}{100}\right)100$$

$$= -0.79 \text{ per cent}$$

Where 151.2 = average lb./bbl. of gas, and 349.9 lb./bbl. of water.

5. C$_5$ and lighter as liquid.—In case propane is sold as a liquid product or propylene from refinery gases is sold, polymerized, alkylated, etc., a correction must be made to convert from the normal weight yield to a volume yield.

Total divisor = 100 bbl.

Total divisor = 29,736 lb.

Propane sold = 170 lb.

Propylene sold = 240 lb.

$$\text{Correction for propane} = \left(\frac{170}{177.7\times 100}\right)100 - \left(\frac{170}{29{,}736}\right)100$$

$$= +0.38 \text{ per cent}$$

$$\text{Correction for propylene} = \left(\frac{240}{182.7\times 100}\right)100 - \left(\frac{240}{29{,}736}\right)100$$

$$= +0.50 \text{ per cent}$$

Where 177.7 and 182.7 represent lb./bbl. for propane and propylene, respectively.

Total correction = +0.88.

6. C$_5$ and heavier as gas.—It often happens that C_5 and heavier materials are discarded to fuel gas. Under such conditions it is necessary to convert from the normal volume yield to a weight yield, in a manner illustrated by the following example:

Total divisor = 100 bbl.

Total divisor = 29,736 lb.

Gas recovery = 1,490 lb.

C_5 + in gas = 10 per cent (wt.)

C_5 + in gas = 210 lb./bbl.

$$\text{Correction} = \left(\frac{1{,}490\times 10}{29{,}736\times 100}\right)100 - \left(\frac{1{,}490\times 10}{210\times 100}\right)\times\left(\frac{1}{100}\right)100$$

$$= -0.21 \text{ per cent}$$

7. Acid-treating naphthas.—When acid treating cracked naphthas a "correction" is calculated with the aid of Fig. 5, as shown in the following:

Total divisor = 100 bbl.

Naphtha treated = 40 bbl.

Gravity of naphtha, 50° A.P.I.

Acid (98 per cent) treat = 9.5 lb./bbl.

Method = countercurrent.

Predicted recovery (from Fig. 5) = 99.3 per cent.

$$\text{Correction} = (40/100)(99.3 - 100.0) = -0.28 \text{ per cent}$$

8. Gasoline blending.—When extraneous stocks (such as casing head for gasoline) are received for blending with the refinery production, a "correction" must be applied to compensate for the volume contraction (no loss). It is to be noted that such stocks also are to be included as part of the total divisor. Through the use of the correlation shown in Fig. 6, this correction is calculated as follows:

Total divisor	= 100 bbl.
Sp. gr. base gasoline	= 0.7307
Sp. gr. light component	= 0.5867
Δ sp. gr.	= 0.1440

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Volume of light component	= 2 bbl.
Volume of base gasoline	= 18 bbl.
Volume of total blended gasolines	= 20 bbl.
Wt. per cent of light component in blend	8.2
Volume contraction (from Fig. 6)	= 0.40%

Correction = — (0.40) (20/100)
= —0.08 per cent

9. Asphalt oxidation.—Since there is a volume contraction when oxidizing asphalt, Fig. 7 shows the correlation used in calculating the "correction" for this operation.

Total divisor = 100 bbl.
Asphalt charge to oxidizer = 10 bbl.
Melting-point increase = 100° F.
Contraction (from Fig. 7) = 1.5 per cent.

Correction = (10/100) (—1.5)
= —0.15 per cent

The refinery production statements show the yields of dry gas, coke, and wax as weight per cent of the refinery divisor while yields of liquid products are recorded on a volume per cent basis. The total recovery is shown as volume + weight per cent of the refinery divisor. On the other hand, the corrections for the anticipated recovery on individual processes are calculated as weight + volume per cent of process feed. In order to obtain the anticipated recovery as a volume + weight per cent of the refinery divisor, a correction must be made to compensate for the difference in the specific gravity of the refinery divisor and the feed to the process units only when yields of dry gas, coke or wax are obtained.

10. Difference in feed-stock gravity. This means that the correction, difference in feed stock gravity, should be applied to the naphtha reforming, reduced crude cracking, and catalytic cracking operations in this sample calculation. To illustrate for the catalytic cracking operations:

Total divisor = 100 bbl.
Total divisor = 29,736 lb.
Gas produced = 425 lb.
Coke produced = 210 lb.
Specific gravity of process feed = 0.80.

$$\text{Correction} = \left(\frac{425 + 210}{29{,}736}\right) 100 - \left(\frac{425 + 210}{100 \times 8.33 \times 0.80 \times 42}\right) 100$$

= —0.13 per cent

If, for purposes of simplicity, we say that similar corrections for the other two applicable operations would total (—0.06 per cent), the total for the three operations would be —0.19 per cent.

As shown in Table 3, the total of the individual corrections, +2.35 per cent, when added to 100.00, gives a corrected anticipated recovery of 102.35 per cent. Again referring to Table 3, deducting the actual recovery of 101.15 per cent (volume + weight) from the corrected anticipated recovery gives a plant loss of 1.20 per cent. However, the refinery may receive for terminaling certain stocks which are mixed with the regular production, and on which certain handling losses will be experienced. The manufacturing loss will be unduly inflated if such losses are not deducted. Therefore, losses due to commingling, as estimated from a standard procedure, are subtracted from the plant loss to give the actual loss incurred in the manufacturing operations. In this particular example, the manufacturing loss is 1.00 per cent.

The determination of the manufacturing loss provides the final figure needed to obtain the total loss for a refinery. The benefits from an active loss control program best can be assayed by noting the trend of the total loss by periods. Failure to include each division of the total loss can lead to erroneous conclusions. For example, experience has shown that improper accounting has indicated sharp increases in the manufacturing loss. Investigation of such situations revealed, in some instances, that the crude-storage account showed gains during these periods.

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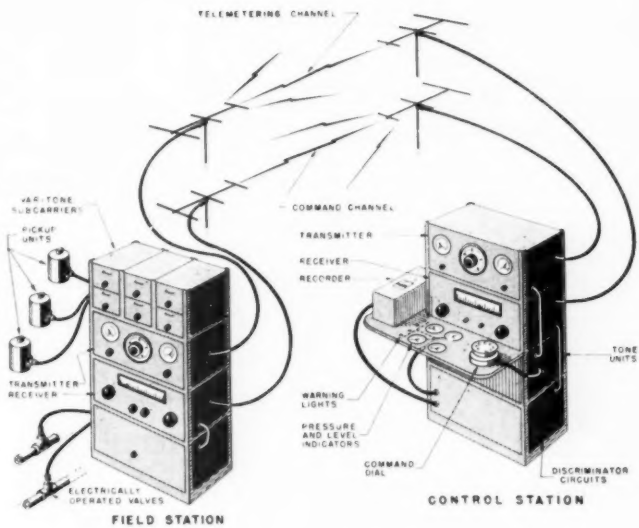
Oil Pumping Control by RADIO



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ACCURATE information on the overall stock loss plus knowledge of the individual loss sources and means for reducing or eliminating such losses is the foundation upon which a stock loss-reduction program can be built. From here on, the problem resolves into the training of field personnel in the latest techniques and procedures for controlling hydrocarbon losses within reasonable limits.

Most of the loss under normal conditions is attributable to evaporation from gasoline tankage and during loading and unloading operations. There are many methods available for predicting tankage evaporation losses. Some are based on theoretical formulas and others on test data. Figs. 1 and 2 are used in Esso operations for estimating breathing and filling losses from fixed-roof tanks. These charts, relating the major variables which influence the rate of evaporation from this type of tank, are based on plant test data and have proved very accurate, particularly over long periods. The data required for use of the

*Material by Committee on Oil Loss Prevention, Esso Standard Oil Co.

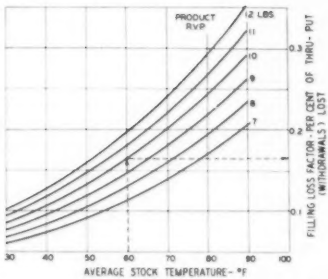


Fig. 2—Filling losses on fixed-roof tanks. Loss in gallons per month equals 0.01 times filling loss factor times throughput in gallons per month

correlations are obtained from plant and laboratory records with the single exception of paint and condition factors which are selected from Tables

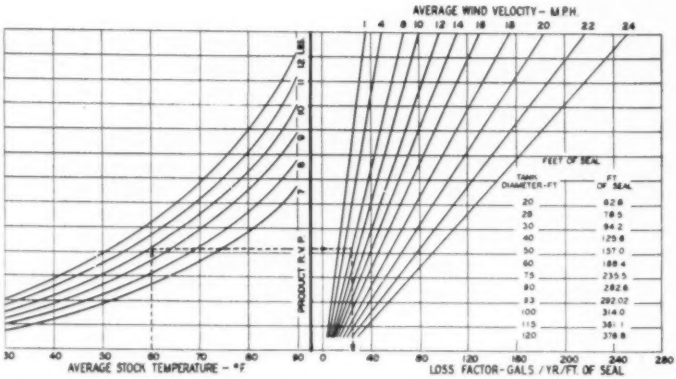

AVERAGE WIND VELOCITY - M.P.H.
PRODUCT R.V.P.
12 LBS.
FEET OF SEAL
TANK DIAMETER-FT
FT OF SEAL
AVERAGE STOCK TEMPERATURE - °F
LOSS FACTOR - GALS / YR / FT OF SEAL

Fig. 3—Evaporation losses on floating-roof tanks. Condition 1 (double Wiggins seal), loss in gallons equals 0.00274 times loss factor times feet of seal times number of days in service during month. Condition 2 (single Wiggins seal), loss in gallons equals 0.00874 times loss factor times feet of seal times number of days in service during month

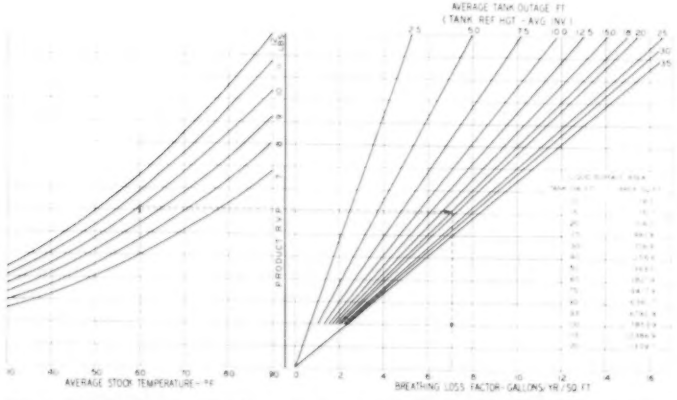

AVERAGE TANK OUTAGE - FT
(TANK REF HGT - AVG INV.)
PRODUCT R.V.P.
AVERAGE STOCK TEMPERATURE - °F
BREATHING LOSS FACTOR - GALLONS / YR / SQ FT

Fig. 1—Breathing losses on fixed-roof tanks. Loss in gallons equals 0.00274 times breathing factor times liquid surface area times paint factor times condition factor times number of days in service during month

1 and 2 after a careful inspection of tank roofs and appliances.

To illustrate the application of the charts, consider the following case.

Operating conditions. — Type and size of tank—cone roof—90 by 42.

Days in service—365.

Tank throughput = 46,200,000 gal. per year.

Average tank outage = 24 ft.

Product R.v.p. = 10 lb.

Average product temperature = 61 F.

Pumping rate into tank = 84,000 gal. per hour.

Pumping rate out of tank = 8,400 gal. per hour.

Product value = 9.1 cents per gallon.

Gastight roof construction—good condition.*

Roof paint—while in good condition.*

Tank shell condition—good.*

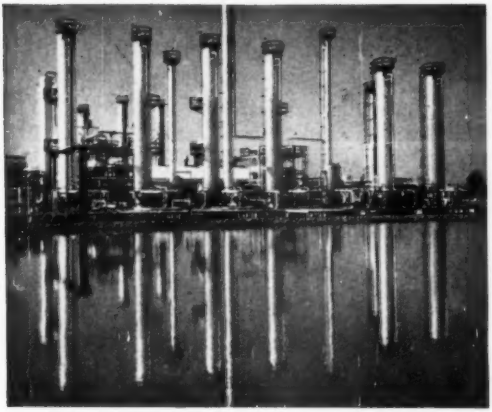
*From field inspection.

CONTROL

SCALE and CORROSION

in

Cooling Towers, Compressors, Engine Jackets



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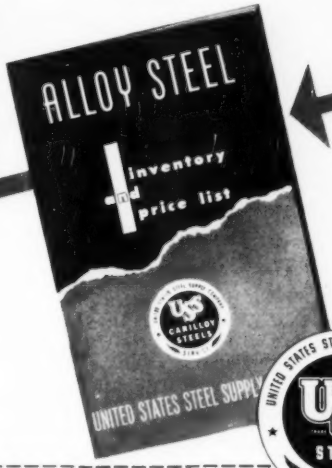

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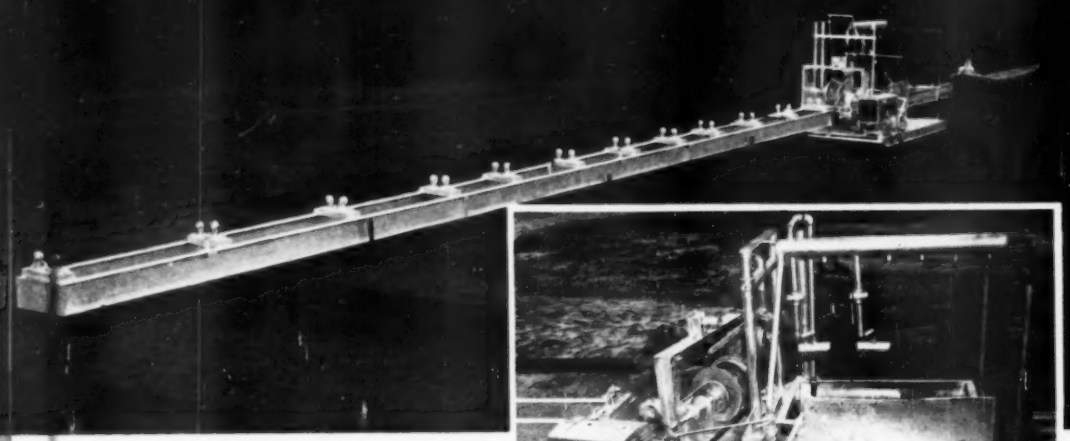

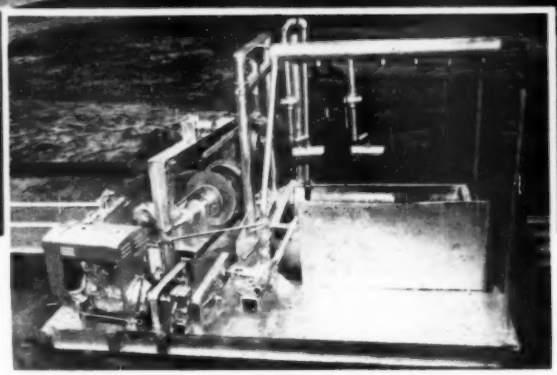

This machine is not a new or untried development. The GMC design has been proved for more than 20 years and the fact that the largest stationary pipe coating companies on the Gulf Coast use this type of machine exclusively is the best testimonial to its efficiency and long-life economy.

CAPACITY

Built to accommodate pipe sizes from 1" through 36".

APPLICATION

Standard Equipment includes:

(a) Manifold for applying 3 coats of enamel to the pipe.

(b) Paper spools for applying 3 wraps of paper, felt, or fibre glass or any combination of same.

REGULATION OR CONTROL

(a) Adherence of the proper thickness of enamel can be controlled.

(b) Elimination of air bubbles obtained by the free flow of enamel thru the air-tite manifold.

(c) Considerable saving of enamel by use of hoppers which can be swung out so that enamel will not flow on ends of pipe.

(d) Correct control of enamel temperature by the insulated working pan and a valve system which permits the enamel to be applied directly from a thermostat controlled standby dope pot* (Not standard part of machine).

(e) Spirally wrapped paper, felt or glass can be applied at correct tension and with proper amount of lap over and maintained by adjustment of rollers on incoming track.

(f) 3 forward speed and reverse transmission provided for dope pump.

(g) 3 forward speed and reverse transmission provided for pipe travel.

(h) Spring loaded drive discs make allowances for crooked and out of round pipe.

CONSTRUCTION

(a) The main part of this machine including engine, drive head, working pan and manifold is unitized on a heavy skid—no dismantling of this unit necessary for moving.

(b) Incoming and outgoing tracks are heavily constructed out of I Beams. Each are in 3—20 ft. sections.

(c) The unit is roller bearing throughout, all shafts are high tensile steel, and working parts safely guarded.

(d) The high interchangeability of parts require a minimum of spare parts all of which we keep in stock, and the majority of which can be found in any fair size town.

(e) Can be furnished with gasoline, diesel or electric power.

(f) The fact that there is but one main unit besides the track, pipe dollies, and paper spools affect great savings in hauling and setting up this equipment.

Write today for complete specification and prices.

GMC

GENERAL MANUFACTURING CO. HOUSTON, TEXAS

TABLE 1—APPROXIMATE CONDITION FACTORS—FIXED ROOF TANKS

Case No. 1—Gas-tight roof equipped with pressure vacuum vent, gas-tight liquid-level-indicator attachment, gas-tight weighted gaging hatch.
In good physical condition—Factor = 1.0
In fair physical condition—Factor = 1.25
In poor physical condition—Factor = 3.0

Case No. 2—Gas-tight roof equipped with a single open vent, nongas-tight gaging hatch, nongas-tight liquid-level-indicator attachment.
In good physical condition—Factor = 1.5
In fair physical condition—Factor = 1.75
In poor physical condition—Factor = 3.0

Case No. 3.—Nongas-tight roof equipped with a single open vent, nongas-tight liquid-level-indicator attachment, nongas-tight gaging hatch.
In good physical condition—Factor = 2.0
In fair physical condition—Factor = 2.25
In poor physical condition—Factor = 3.0

Case No. 4.—Nongas-tight roof equipped with two open vents, nongas-tight gaging hatch, and nongas-tight liquid-level indicator.
In good physical condition—Factor = 3.0
In fair physical condition—Factor = 3.5
In poor physical condition—Factor = 4.0

Case No. 5.—Nongas-tight roof with Johns-Manville insulation roof, pressure vacuum vent, gas-tight gaging hatch, and oil-sealed liquid-level-indicator attachment.
In good physical condition—Factor = 1.25
In fair physical condition—Factor = 1.5
In poor physical condition—Factor = 3.0

Case No. 6.—Nongas-tight roof with Johns-Manville insulation, single open vent, nongas-tight gaging hatch, and nongas-tight liquid-level-indicator attachment.
In good physical condition—Factor = 1.75
In fair physical condition—Factor = 2.00
In poor physical condition—Factor = 3.0

TABLE 2—APPROXIMATE PAINT FACTORS—FIXED ROOF TANKS

	Good paint	Needs repainting
J-M insulation	1.0	1.0
White	1.0	1.5*
Light grey	1.1	1.5*
Aluminum	1.2	1.5*
Yellow brown	1.25	1.5*
Olive drab	1.4	5
Red or black	1.5	1.5
No paint		1.5

*When 10 per cent of prime coat is exposed.

TABLE 3—EXAMPLE CALCULATION, TRANSPORTATION LOSS

Vessel—Esso Transport (all quantities barrels at 60° F.).
Loaded—Refinery, 2-12-49 at 60° F.).
Product—Heating oil.

Shore tank		100,000
Vessel—measured quantity	99,000	
Experience Factor (multiplier)	0.9979	
Corrected quantity		98,792
Loading variation		1,208
Loading variation, per cent		1.21
Unloaded at: Terminal A—2-25-49		
Vessel—Measured quantity	98,800	
Experience Factor (multiplier)	0.9979	
Corrected quantity		98,592
In-transit variation		200
In-transit variation, per cent		0.20
Shore tank		98,660
Unloading variation		68
Unloading variation, per cent		0.07
Over-all variation		1,340
Over-all variation, per cent		1.34

From Fig. 1—Breathing loss factor —7.9. Surface area = 6,361.7 sq. ft.
Fig. 2—Filling loss factor = 0.167.

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Table 1—Condition factor = 1.0.
Table 2—Paint factor = 1.0.

Applying equations on Figs. 1 and 2—Breathing loss = 0.00274 × 7.9 × 6,361.9 × 1.0 × 1.0 × 365 = 50,264 gal. per year.

Filling loss = 0.01 × 0.167 × 46,200,000 = 77,154 gal. per year.

Total evaporation loss, 127,418 gal. per year.

Figs. 3 and 4 are used for estimating evaporation losses from floating-roof tanks and in loading tank trucks and tank cars by the splash method. With the exception of the average wind velocity which is obtained from the local weather bureau or airport, the data necessary for using these charts are available in the plant records. Where submerged fillers are available for loading tank trucks and tank cars with motor and aviation gasolines, the loss is estimated at 0.1 per cent of the loaded quantity.

Fig. 2 is also used in calculating filling losses from 2½ lb. pressure

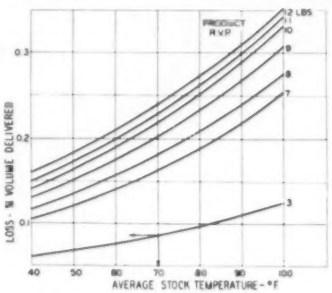


Fig. 4—Filling loss in loading tank cars and trucks by splash method

tankage. There is no breathing loss in this type of storage. Other losses, such as pump leakage, line leaks, etc., are measured, or where this is impractical, are based on plant estimates.

To illustrate the application of these principles to the operations of a typical terminal, let us consider the case of Terminal A, a marine terminal which receives products via tanker and distributes them by barge, tank car, and tank truck.

Since the products are purchased f.o.b. at the shipping point, the control in this case begins at the supplier's plant. There are two types of suppliers, (1) those who properly verify the accuracy of invoiced quantities prior to invoicing and (2) those who always bill on the basis of their shore-tank measurements without verification. Since the principles applied in either case are essentially the same, we shall review the first case in detail and then explain the additional work required in controlling losses where the supplier does not verify his quantities prior to billing.

Control of losses in the transportation operation is possible through the use of the quantity calculated from tanker ullages, temperatures, and calibration charts as a secondary check on the accuracy of shore tank measurements. To be specific, by applying accepted statistical procedures to data on previous voyages of a given tanker, an "experience factor," which is the ratio of the shore and tanker quantities when all measurements are accurate and no abnormal loss occurs, is established. Comparison of this factor with the variation in shore and vessel quantities for a particular loading or unloading indicates where an error or physical loss has occurred. For example, consider the case shown in Table 1.

From the 1.21 per cent loading variation, Table 3, the supplier knows immediately that some error has occurred in determining the shore-tank delivery, the tanker receipt, or that some condition ashore, possibly in the loading lines, has introduced an error into the indicated delivered quantity. An immediate investigation may disclose where the error or loss occurred. However, due to the complexity of the shore facilities, it is often impossible to trace down the loss, but the question remains—How much product was delivered into the customer's tanker? The solution would be easy if the tanker were accurately calibrated and billing could be made on the tanker quantity, but this is seldom the case. Another solution is for the supplier to contact with the customer and obtain the outturn data.

A tabulation of all of the data as given in Table 3 indicates that the error occurred in loading shore quantity and that actually the delivery was 98,860 bbl. (outturn shore tank plus in transit variation) instead of the 100,000 bbl. measured in the supplier's tank. Billing is then made for the correct quantity. By following this procedure, the supplier insures the customer of fair treatment, protects himself against product giveaway, and permits undesirable shore conditions to be detected and remedial measures initiated. The receiving terminal also has a responsibility, i.e., to subject the outturn to the same analysis and thereby insure an accurate measure of the receipt. Thus, with an accurate invoice and outturn, the only excessive loss which may occur would be an actual physical loss from the tanker while in transit. Such losses are recoverable through claims against the carrier.

Now suppose that instead of verifying the invoice quantity prior to billing, the supplier merely charges on the basis of his down-gage shore-tank measurements. Upon receipt of the cargo and verification of the outturn by Terminal A, a shortage of 1,340 bbl., or 1.34 per cent exists. The customer must then compare the data as in Table 1 and, as before, it is evident that the error occurred in the supplier's shore-tank quantity. This loss is recoverable upon presentation of a claim to the supplier. Had the loss been in transit the claim would be against the carrier.

Inventory control is possible through the establishment of a standard procedure for taking and reporting inventories which embodies the following principles:

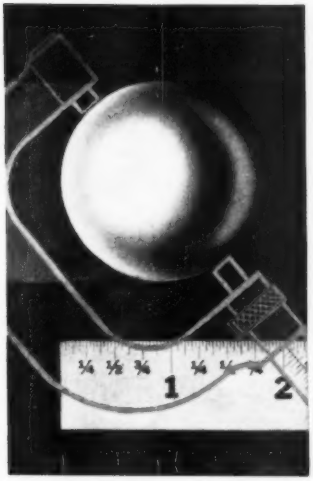
TABLE 4—COMPARISON OF MOTOR-GASOLINE LOSSES
(All quantities 60° F. gallons per month)

Terminal	A	B
Actual plant loss—gallons	50,606	53,790
—Per cent of deliveries	0.52	0.36
Calculated losses with existing facilities in actual condition		
Tankage evaporation	41,966	47,191
Pump leakage	212	0
Tank-truck loading	7,413	2,973
Total—gallons	49,591	50,164
—per cent deliveries	0.51	0.33
—per cent of actual	98	93
Calculated losses with tanks repaired, roofs painted white and submerged loading facilities		
Tankage evaporation	25,327	35,414
Pump leakage	0	0
Tank truck loading	4,716	1,746
Total (plant goal)—gallons	30,043	37,160
—per cent deliveries	0.31	0.25
Savings		
Tankage repair—gallons per month	16,639	11,777
—per cent deliveries	0.17	0.08
—Dollars per year	20,000	14,100
Submerged filling—gallons per month	2,697	1,227
—per cent deliveries	0.03	0.01
—Dollars per year	3,200	1,600
Total—gallons per month	19,548*	13,004
—per cent deliveries	0.20	0.09
—Dollars per year	23,200	15,700
Approximate tank-repair cost—dollars	3,000	3,500
Payout — months	1.8	3.0
Approximate cost of submerged filling equipment—dollars†	4,100	4,500
Payout — months	15	34

*Including 212 gal. per month reduction in pump leakage.
†Includes cost of fillers, piping, and installation.

ONLY A BALL

has { one dimension / one surface



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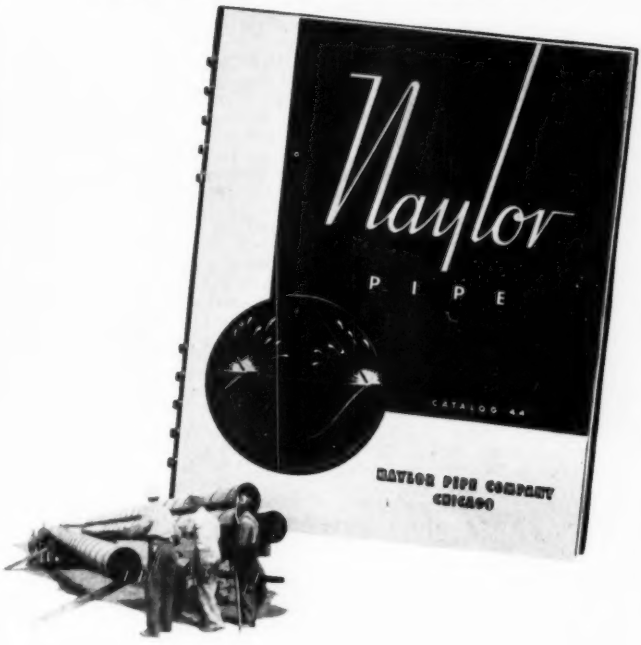

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1. Responsibility for the accuracy and proper conduct of the inventory must be assigned to one person, preferably the terminal superintendent.

2. Measurement, calculation, and reporting procedures must conform with company standards.

3. Routine check procedures must be established to permit gross errors in the inventory to be detected and investigated promptly. Figures which appear to be out of line can often be substantiated or indicated to be in error through comparison with the previous day's pumping reports, inventories, etc.

Control on deliveries varies with the type of transportation media provided. However, the principle upon which the control is based remains the same, i.e., measure the same delivery at two or more different locations for comparison.

In the case of barge shipments, the quantity measured in the barge provides a check on the accuracy of the shore-tank delivery. The procedure is essentially the same as that described for the verification of tanker receipts and deliveries.

Tank-car deliveries are verified by comparison of the total quantity of product measured in a string of cars with the total quantity as computed in the supplying shore tank.

Control of truck loading is also possible. Where loading-rack meters are available, the first step is the establishment of standard meter- calibration procedures which require regular and frequent checks on meter accuracy as measured by an accurately calibrated prover tank. Any deviation in the accuracy of loading-rack meters is detected by routine comparison with the quantity as measured in the calibrated truck compartments. A three-way check is possible on short hauls which are metered from the truck, viz.: loading-rack meter vs. truck-compartment calibrations vs. truck-meter readings.

Control procedures have been applied, under test conditions, to the operations of two terminals within the Esso Marketers interests. The first was previously referred to as Terminal A and the second, Terminal B, is a pipe-line terminus which delivers over 85 per cent of its products by barge. Results of this work are summarized in Table 4.

A direct comparison of the losses reported by the two terminals would appear to show that Terminal B is operating more efficiently, from a stock loss-control standpoint, than Terminal A. However, analysis of the operations at both plants proves that Terminal A cannot be expected to operate with as low a stock loss as B even when all of the tanks are reconditioned and submerged truck-loading facilities provided. The minimum losses with reconditioned tankage and loading equipment are shown as 0.31 per cent and 0.25 per cent of deliveries for plants A and B, respectively. Using these "loss goals" for the two plants, it is evident that Terminal A was at 167 per cent of the objective whereas plant B was at 144 per cent of its goal. The somewhat closer approach to the objective at B was attributable entirely to the better average mechanical condition of the roofs and appliances on the storage tanks at Terminal B.

While the data indicate that Terminal B is within 44 per cent of its goal vs. 67 per cent for A, it is interesting to note that savings from gas tightening and repainting the tanks at B are 71 per cent of those which were shown possible for a similar repair program at Plant A. This is due, of course, to the larger number of tanks in service at the pipeline terminal. Further investigation also disclosed that the losses at B could be reduced by an additional $22,000 per year through the use of a vapor balance system.

Referring again to Table 4, it can be seen that calculation of the losses under existing conditions provides a measure of plant efficiency in controlling the losses within the limits imposed by the condition and nature of the facilities provided. The control in both plants appears to be good as evidenced by the close agreement in calculated and actual loss figures, i.e., 98 per cent of actual for A and 93 per cent for B. Any excessive deviations would indicate that a major unaccounted for loss occurred or some undetected error had occurred in determining invoiced, received, or inventory quantities.

In summary, the loss-control program of Esso Standard Oil is predicated on first, accurately determining the magnitude and value of the loss. Once the dollar potential is established, work can go forward on the isolation, reduction, and elimination of the individual sources of loss, the final step being the establishment of the control procedures necessary to keep the losses within reasonable limits. The success of the program rests with the individuals responsible for its prosecution so that only carefully selected and trained personnel are assigned to this work.

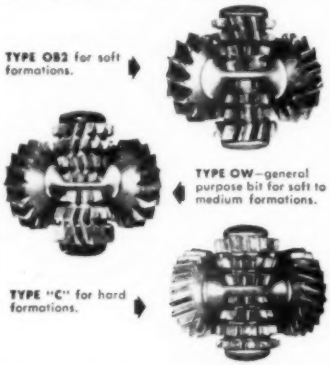
BOOKS

ANNUAL REVIEW OF CRUDE-OIL PRODUCTION. Published by Conservation Committee of California Crude Oil Producers, 417 South Hill Street, Los Angeles.

This annual review is a complete statistical report of California's oil industry, and of the activities of the Conservation committee. It is divided into several chapters. These have to do with oil production, geology, development and new completions, gas production and development, committee membership, significant statistics of fields and pools, field and company group totals, and many other headings. The report is published in loose-leaf form. According to the report, drilling in 1948 was at an all-time high with 2,131 new oil wells completed, which was 550 more than for 1947. Wildcat drilling was also at a peak with 488 exploratory wells drilled, or 136 more than in 1947.

A Revolutionary New Tool Combining Security Rock Bit and Security Reamer Advantages

Selection of the proper Reamer Rock Bit type for a specific formation increases footage per bit. There is a type of Security Reamer Rock Bit for fast, economical drilling of surface hole formation.



The Security Reamer Rock Bit incorporates cutting principles found only in the Security Reamer. Formations are sheared away, rather than being rolled or crushed into the walls of the hole. Upward shear is developed as the reamers are rotated, thus cutting wall surface smoothly and

forcing the cuttings upward into the mud stream. To the upward cutting action is coupled a downward thrust that actually aids the drilling bit. Locking devices on Reamer Rock Bit cutters are the same as on the Security Reamer and the cutters may be changed at the rig by the use of simple hand tools. When you drill with a Security Reamer Rock Bit you have assurance of full gauge, smooth cylindrical hole for setting casing.

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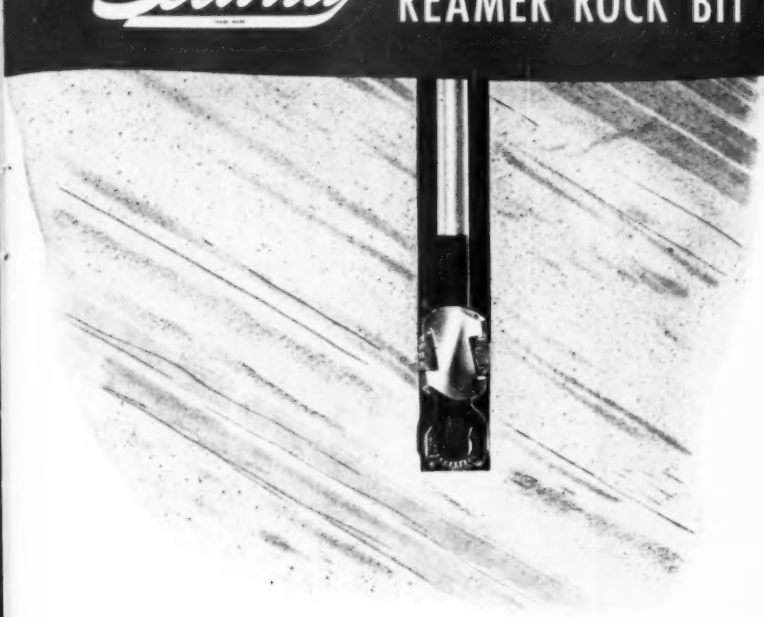

In West Texas, in the Rocky Mountain area, in California, drillers are enthusiastic over the performance of the new combination Security Reamer Rock Bit.

Designed for surface hole drilling, this tool combines the field-proven advantages of Security Rock Bits with the stabilization and reaming efficiency of the Security Reamer.

Not only does the Reamer Rock Bit give increased footage per bit but it provides full gauge round hole. The two angularly set reamer cutters contact a large percentage of wall surface, assuring drill pipe stabilization that also leaves the hole in perfect condition for setting surface pipe. An extra long shank is provided above the reamer rock bit in the event it is necessary to run fishing tools.

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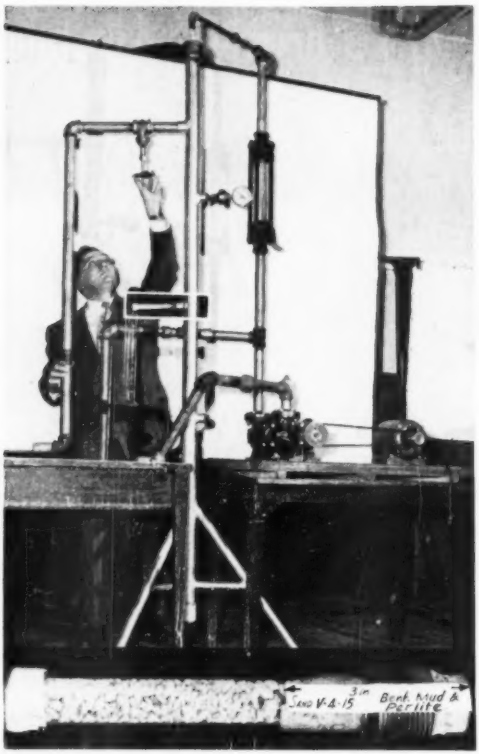


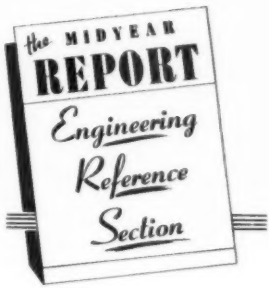
PERLITE

used as mud-additive material proves highly effective in tests in combating

Lost Circulation

by Efrain E. Barberii*

Fig. 1—Laboratory experiments proving effectiveness of perlite as a lost-circulation material were carried out in apparatus shown here, with the author. Plastic tube is filled with a sand and fitted into vertical pipe. Efflux of water is measured to determine plugging rate. In plastic tube shown, with perlite, there was no lost circulation



LOSS of circulation and returns in rotary drilling can be one of the most expensive mishaps during the drilling of an oil well. The search for a mud additive for the prevention of circulation losses or for regaining circulation after it has once failed is intensive and has brought many natural and manufactured products to the fore. One of the most recent of these is a mineral known as perlite, a gray siliceous lava composed of spherules, which upon heating will expand to many times its normal volume and disintegrate into fine and voluminous particles. It is the heated and expanded product which is used to fight lost circulation and is the subject of this paper.

Selection of Material

Any additive material employed to combat loss of circulation has to conform to certain physical and chemical specifications in order to function properly. The material should be highly incompressible, temperature resistant, and preferably granular or flaky in appearance. It should be strain resistant, however, and under disturbance it should rearrange itself readily to form a stable seal which will greatly reduce or completely impede the flow of its carrier fluid through the porous media. The material should be chemically inert, to resist decomposition and organic decay. All of these characteristics are of primary importance, because the stability of the bulk agent, within the offending formation, determines the effectiveness of the plugging action created by the bridging material.

With the aforementioned factors in mind, the search for an adequate material began. Perlite was found to meet the necessary requirements and therefore was selected to be tested.

Perlite, in the raw-ore stage, contains 2 to 5 per cent water. Expanded by heat of about 1,700° to 2,200° F., the material loses weight, and a gain in volume of more than 600 per cent takes place. The expanded perlite is a complicated aluminum silicate almost identical to the better grades of bentonites. Perlite has been used recently as a building-material aggregate, and the results obtained have been highly satisfactory.

TABLE 1—SCREEN TEST
Perlite aggregate (2F)

Screen number	Size openings	Percentage of material, by weight, in grams, remaining on respective screens
10	2.000	16.9
20	0.840	44.7
30	0.590	
40	0.420	22.7
60	0.250	10.9
100	0.149	4.4
200	0.740	0.4
Through 200		trace
Aggregate material		
Weight per cubic foot, pounds		14.95
Specific gravity		0.24

The refined product of crude perlite used in these experiments was screened and graded. Screening and grading was done under laboratory conditions, subject to the limitations of the testing apparatus. Under actual field conditions any desired grading can be selected in order to meet specific requirements.

Procedure of Testing

To carry out the proposed experiments a primary requisite was to simulate the circulating system of a well under actual drilling conditions. This condition was attained by building the apparatus pictured in Fig. 1.

Regardless of the fluid used—be it alone or mixed with the perlite aggregate—each experiment was run as follows. The drilling fluid deposited in the tank was picked up by the pump and circulated through the drill pipe and down the well and returned to the tank again. The glass tube loaded with the thief sand was screwed into the well, and any fluid flowing through the porous formation was caught in a graduated cylinder and measured with respect to time.

*Instructor, production department, school of petroleum engineering, University of Tulsa

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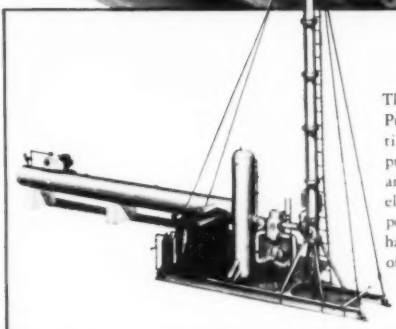

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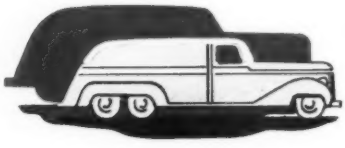

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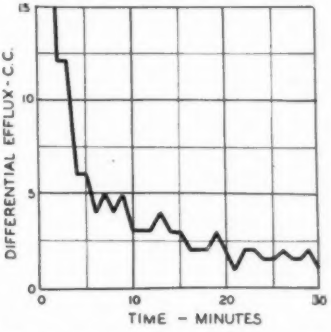

Fig. 2—Plugging rate of perlite in plain water

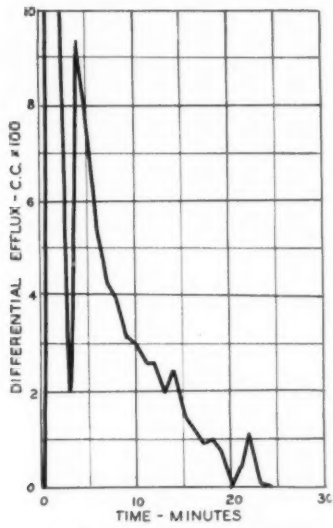

Fig. 3—Plugging rate of a plain bentonitic mud

The cumulative and differential flow thus obtained was plotted on Cartesian coordinate paper. This type of paper was selected in order to show clearly the hydraulic effect of the circulating fluid on the face of the formation, and to show the following conditions:

1. Plugging action of the fluid, by itself.
2. Plugging action of perlite, when carried by each fluid.
3. Plugging action of perlite, when carried by each fluid, under pressure.

The selected fluids were water, bentonitic mud, and cellulose mud. Only condition 2 was observed when circulating water loaded with perlite, since water is a true, mobile fluid lacking inherent colloidal properties. Using bentonitic and cellulose mud, conditions 1, 2, and 3 were observed.

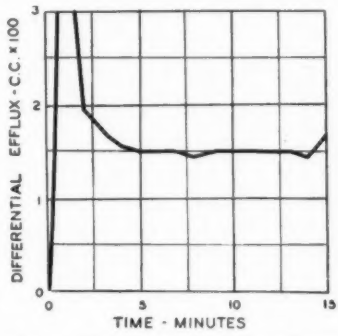

Fig. 4—Plugging rate of a plain cellulose mud

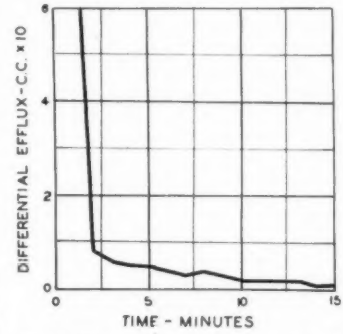

Fig. 5—Plugging rate of a cellulose mud with perlite

These four charts provide a graphic comparison of the relative merit of ordinary muds and muds with perlite added. All tests shown here were made on a sand which had a permeability index in excess of 60,000 md.

The sands selected to be tested with the bentonitic and cellulose muds were chosen because they represented a good cross-section of porous media from a medium to a highly permeable and porous range.

Experimental Data and Interpretation

Experiments with water. — Water alone flowing through the different sands selected gave a direct means to calculate the approximate permeability of each sand used. One of the sands had an average of 3,870 md., and three others averages of 8,100, 15,000, 24,000 md. Three other sands which were extremely porous and therefore had a larger void space, had permeabilities greater than 24,000 md. The coarsest sand of all may have had a permeability index greater than 60,000 md. Correct measurement by direct means was hard to obtain, owing to the excessive efflux.

To the water, 0.24 lb. of perlite per gallon, or 10 lb. per barrel, was added and thoroughly mixed. Each sand in turn was placed in the formation holder, or tube, and the water-perlite mixture circulated to observe the results. Fig. 2 shows results obtained with a very coarse sand. The curve shows the plugging effect and hydraulicking action of the fluid.

In this particular case it is to be noted that Fig. 2 shows remarkably the plugging effect of the perlite. The perlite material went in readily and reduced considerably the flow of water through this sand, the coarsest of all.

Comparison of two sets of curves like these shows that the penetration and bridging action of the bulk agent are necessary characteristics in combating loss of circulation. This can be readily seen since the sand used in the illustration is highly permeable and during the 30 minutes' circulation the efflux through the sand was only 1.3 greater than the efflux obtained through the least permeable of the sands. The trend of the slope of both curves shows the plugging effect.

Experiments with bentonitic mud.— Fig. 3 shows the plugging action of a pure bentonitic mud of the following characteristics:

Weight, pounds per gallon	8.70
Marsh viscosity, seconds	40.00
Water loss, cc.	12.00
Cake thickness, 32nds	2.00

The magnitude and frequency of the differential efflux, as expressed by the plate, show that this particular mud effects a loss of fluid through the formations, diminishing nearly uniformly with respect to time. At times the plugging action seems to have been very stable, but not so stable as to give a complete seal.

After the addition of 10 lb. of perlite per barrel of mud, the bentonitic-perlite mud had the following characteristics:

Weight, pounds per gallon	8.77
Marsh viscosity, seconds	43.40
Stormer viscosity, centipoise	24.00
Water loss, cc.	9.00
Cake thickness, 32nds	2.00

The bridging effect created by the perlitic material within the formations, regardless of pore space, was very effective. No loss of fluid was recorded; the mud loaded with perlite penetrated some distance in the formation and caused a complete seal or arrest of any loss of fluid.

Similar experiments run under pressure gave nearly the same results.

A block diagram shows the same pluggability and diminished loss of circulation as without pressure but with better sealing effects than mud acting by itself within the formation. Again it can be said that penetration and the bridging action by the bulk agent employed are fundamental factors in stopping loss of circulation or loss of returns.

Experiments with cellulose mud.—

Fig. 4 shows the plugging action of a cellulose mud through the highly permeable sand. The experiments were run in an identical manner as the experiments performed with the bentonitic mud. The cellulose mud had the following characteristics:

Weight, pounds per gallon	8.60
Marsh viscosity, seconds	45.00
Water loss, cc.	53.00
Cake thickness, 32nds	Extremely thin film

Efflux was obtained through only one sand, the others were completely plugged.

Fig. 5 shows an experiment done with the cellulose-perlite mud through the same sand as used above under a sustained circulation pressure. It can be seen that even though efflux through all sands was obtained, the total throughput in each case was greatly diminished. The penetrating and bridging action of the perlite, within the formation, was responsible for creating a stable seal of the porous media.

During the past few months expanded perlite, especially selected for use in wells,* has been successfully tried at various depths in several different areas for regaining lost circulation. The depths have been from 2,250 ft. in the Layton sand in Osage County, Oklahoma, to approximately 13,000 ft. in the Texas Panhandle. Other wells tested were in the Mexia fault zone, southeast New Mexico, southern Oklahoma, Montana, and West Texas.

A brief history of a few typical examples is as follows:

Well A.—Lost circulation in a well in the Texas Panhandle at total depth of 7,500 ft. Suspected depths of trouble were at approximately 5,400 ft. and bottom of hole, the well having repeated trouble over a period of several months. Usual methods including cementing failed to gain returns. Eighteen hundred cubic feet of perlite were spotted in hole and full returns established.

Well B.—Lost circulation at 8,868 ft. Failed to establish circulation by repeated cementing and other usual methods. Approximately 1,000 sacks of perlite in bentonite drilling fluid established full returns and enabled company to diamond core and set casing.

Well C.—Mexia fault zone well had repeated lost circulation below 8,800 ft. on 9,000-ft. contract. Nine cement plugs had failed to restore circulation. Approximately 1,200 cu. ft. of perlite was used to regain full returns and reach contract depth.

Well D.—Well in Texas Panhandle lost returns at 3,700 ft. uncovering water sand beneath surface casing, resulting in a costly fishing job. After recovering fish, full returns were secured with perlite and the well was drilled 160 ft. deeper. Circulation was regained with approximately 100 cu. ft. of selected perlite.

Well E.—Well No. 9 on lease in Osage County, Oklahoma, where all previous wells drilled on lease had lost circulation in Layton sand, requiring several thousand dollars in materials and day work. Perlite was added to bentonite drilling mud before reaching the Layton. No returns were lost until 2,600 ft., but circulation was regained in a few minutes. A second well has since been drilled on this lease without losing returns.

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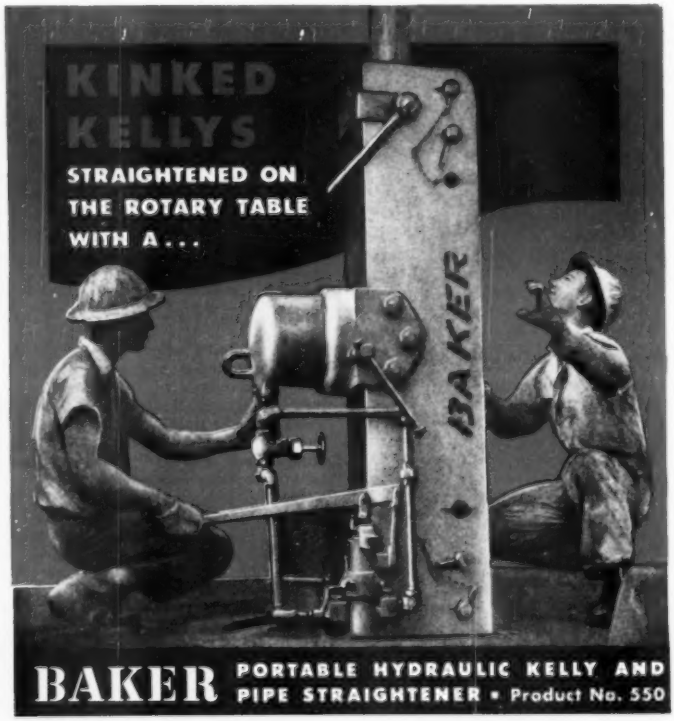

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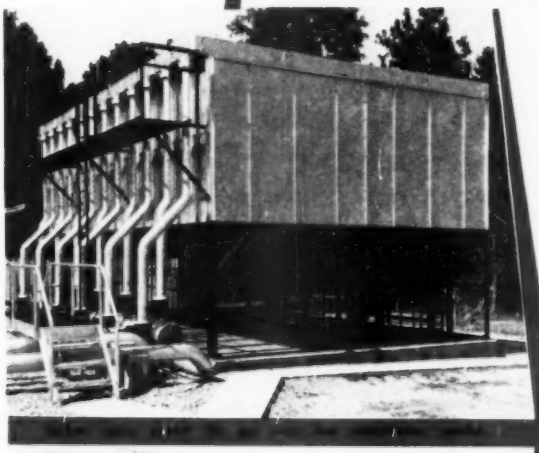

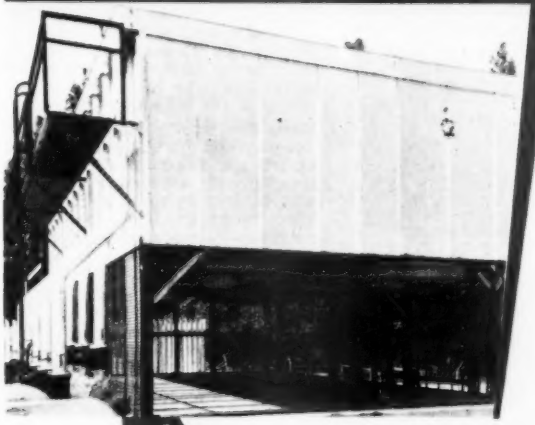

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OIL RESERVES AND SECONDARY RECOVERY

. . . Use of Gasoline Suggested in Repressuring

by Ernest C. Arnold*

FOR many years we have heard rumors of the depletion of our oil reserves and retaliating assurances that we have all of the oil we will need or can use for many decades.

Prior to the last war, the general public did not concern itself in this discussion, not only because it felt that the United States has a more efficient and resourceful oil industry than any other country and that as long as there is oil in the world we will get our share, but also felt proud of the fact that we were producing over 60 per cent of the world's supply of oil. However, during the last war it was forcefully brought to the attention of all of us that our national security is definitely related to our readily available oil reserves from which we can produce the necessary amount of oil in the event of another war. The public is now very much interested in our oil reserves.

When oil was discovered in 1859, there was a definite number of oil fields in the United States and likewise in the world. This number has not changed, because the formation of oil and its migration into pools or fields in recoverable quantities required millions of years. No conceivable accumulation could have occurred in the 90 years since the discovery of oil. Each time an oil field is discovered, there is one fewer left to discover. For this reason the finding of new oil is becoming progressively more difficult and more expensive.

Five General Oil Areas

The oil fields in the United States have been found in five general areas: the Appalachian, the Mid-Continent, the Rocky Mountain, the Gulf Coast, and California. In these areas the major portion of the shallow and more easily discovered fields have been discovered. We are now searching for the deeper and the more scattered fields. Thirty years ago a well 4,000 ft. deep was classified as a deep well. Now many of our wells are over 10,000 ft. in depth. It is obviously uneconomic to search for small pools at such depths.

The costs of finding new oil has greatly increased both because of the general increase in the cost of all

commodities and because of the deeper drilling. Within the last 10 years the per barrel cost of finding new oil has increased from about 10 cents to about $1. This cost does not include the cost of development or production after a field is discovered. It is the cost of finding the new fields.

It is interesting to note that our reserves of oil have steadily increased even though our consumption of oil has greatly increased and the finding of new oil has become more difficult. This fact can be very misleading unless the method of estimating the reserves is understood.

Summation of Estimates

The method of estimating the reserves is simple enough. It is merely a summation of many estimates. An estimate is made of the quantity of oil that can be recovered from each field by the method of production in use in the field. The total of these estimates is our reserve supply of oil. Each time a field is extended or an improved method of production is commenced, the recoverable oil from the field is increased and in turn our total reserves are increased. From the foregoing it may be seen that our reserves have been maintained both by finding new oil and by the application of more efficient methods of recovering the oil already discovered. It is also plain that the estimates will vary to some extent.

It has been 15 or 18 years since we have discovered as much new oil as has been produced during the calendar year. According to the generally accepted estimates and using round numbers, in the last 14 years 8 billion barrels of new oil have been discovered but 25 billion barrels have been added to our reserves by extensions of fields and by upward revisions of the recoverable oil because of improved production methods. In this way 33 billion barrels of oil was added to our reserves. During the same 14 years, 21½ billion barrels of oil and gas liquids were produced. In the 14 years the net gain in our reserves was 33 billion minus 21½ billion or 11½ billion barrels. Thus our reserves were increased from 14½ billion barrels on January 1, 1935, to 26 billion barrels on January 1, 1949.

In 1948 the new oil discovered was approximately 750 million barrels, which equaled the production of about 130 days. If the past 14 years is a criterion by which we can judge the future, it seems rather obvious that our future reserves of oil are to come principally from improved methods of production and not from new discoveries as many have supposed.

If our future reserves and consequently our national security are becoming more and more dependent on production methods it might be well to take stock of these production methods and ascertain whether they are based on expeditiousness and ultimate wastefulness or whether they are based on the maximum ultimate recovery.

Until about the time of the first World War the consumption of oil was not very great. The automobiles, tractors, and trucks were comparatively few, and aviation was in its infancy. Consequently, the efficiency of production methods was given little thought beyond producing as much oil as possible as economically as possible, with little or no thought beyond immediate economics.

Our first shortage of available oil was in 1918. This shortage was not serious and has been almost forgotten. The price of oil went up to over $3 a barrel, wartime consumption was discontinued, and it was not long before there was a surplus of oil.

At about this time the petroleum geologist began to come into his own and there was an occasional petroleum engineer; also at about this time many colleges and universities established petroleum-engineering schools. In the early 1920's a petroleum engineer was often facetiously referred to as a geologist who had seen an oil well.

Petroleum-Engineering Specialists

In the last 30 years the petroleum engineer has come a long way. So far, that the title is now hardly appropriate. Instead we have specialists; gas engineers, development engineers, primary production engineers, repressuring engineers, water-flood engineers, and many other classifications. These engineers have done a wonderful job. Otherwise our re-

*Office of Indian Affairs, Muskogee, Okla.

serves would be more comparable to Mexico's.

Until the advent of the petroleum engineer, little or no thought was given to the conservation of the energy in the fluid compressed in the oil sand. A well that would flow was permitted to flow as long as it would and as fast as it would and then it was pumped as long as it showed a profit. It is generally conceded that this method of production recovered only 15 to 20 per cent of the oil that was in the field when it was discovered. The remaining 80 to 85 per cent was left as unrecoverable. Most of the old stripper fields of today were originally produced in this way.

By secondary recovery, that is, by repressuring with gas or by waterflooding another 20 to 25 per cent of the original oil is recovered. Thus after the original or primary production is completed and the field has been repressured or water flooded about 40 to 50 per cent of the original oil has been recovered and 50 to 60 per cent of the oil is abandoned as unrecoverable.

Fields which have been discovered in more recent years probably will produce a larger percentage of the oil by primary methods than the older fields did, because the energy in the sand is now being better conserved and utilized. Also, many of the newer fields are at far greater depths than the older fields, with greater pressures and more potential energy in the fluids. Because of the greater amount of energy and its better conservation, the percentage of oil recovered by primary methods has increased. However, this is offset to an unknown degree by the wider spacing of wells.

Combination of Methods

Secondary methods, as the name indicates, normally follow primary methods, but in the most modern practice the primary and the secondary methods are being combined. This is done by pressure maintenance through gas injection, gas recycling, and by utilization of natural water drives.

To accomplish a combination of methods some preliminary steps are desirable. Preferably the field should be unitized or at the very least the lessees should agree on a procedure of cooperation. Although unitization is better, it is sometimes rather difficult, or even impossible. The state regulatory body should prescribe a spacing rule and prorate the production equitably to encourage the procedure. This is the accepted practice. The combination of methods reduces development costs by permitting wider spacing of wells; also it prolongs the flowing life of the wells, and thus reduces the per barrel production costs. Even more important, the combination of methods increases the ultimate recovery by as much as 10 to 15 per cent of the oil in place, which

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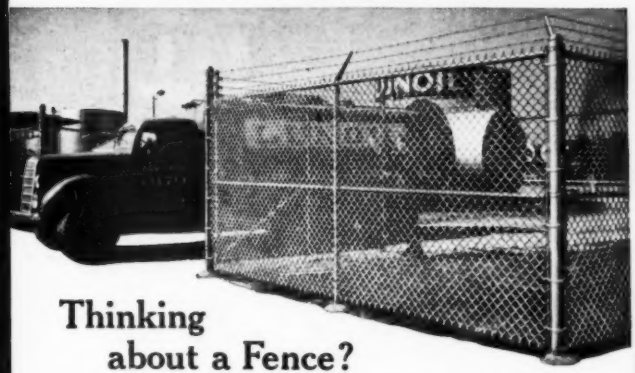

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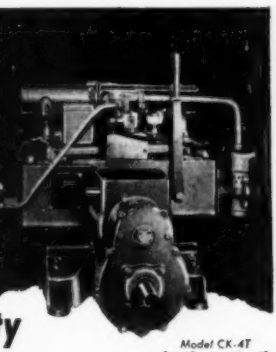

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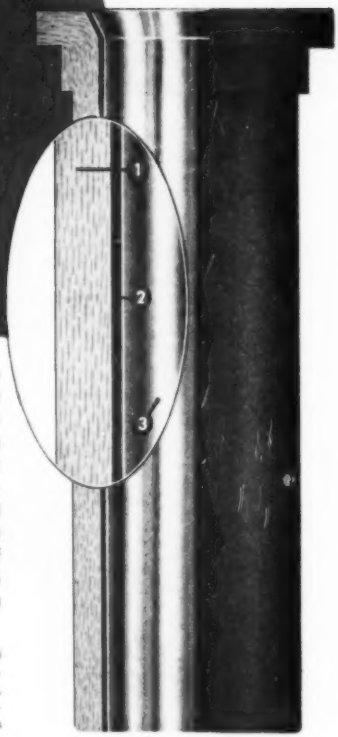

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is a recovery percentage of 25 to 35.

This combination of methods should and does receive wide acclaim, but it also creates another situation which we should pause and consider rather carefully.

By the best methods of secondary recovery now known, an oil sand can be depleted to only about 40 to 50 per cent of the original oil. Although these methods are costly, the old primary methods left about 30 to 35 per cent of the oil to be recovered in this way, which is sufficient in many fields to warrant the expense of the secondary operation. Now the situation is changing; the combined method of production leaves 65 to 75 per cent of the original oil. And, since the methods of secondary recovery now in use can deplete the sand to not over 50 per cent, it is simple arithmetic that only 15 to 25 per cent of the original oil will be left for the secondary method.

It appears plain that since it requires careful management and good engineering to make a profit from secondary operations when 25 to 35 per cent of the original oil is available, it will be uneconomic to attempt to recover the 15 to 25 per cent left by the present methods. Therefore, unless we find some new or improved method of secondary recovery to follow the combined method, it may be that in the future we will leave from 65 to 75 per cent of the original oil in the sand when the field is finally abandoned. This is too much oil to leave as unrecoverable, and, is considerably more than is now being left by the old primary method followed by a secondary method. The combined method has this, among other things, in its favor; it probably will be used in a greater percentage of the fields than the two methods were.

There is another gloomy side of the present picture. If our search for new fields takes a turn for the better, and the confidence that this will happen is the incentive for so much wildcatting, oil from the newer fields produced by the combined method, with its lower development and production costs, augmented by cheap foreign oil, may cause such a drop in the price of oil that secondary recovery by existing methods will become unprofitable even in the more prolific of the old fields, thus forcing a discontinuance of secondary recovery as well as permanent abandonment of stripper wells.

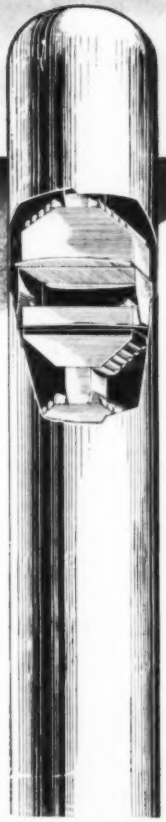
Present Methods Not Adequate

It should be construed that the wisdom of the combined method is being questioned, but it does appear that the methods of secondary recovery are inadequate.

It is recognized that a large portion of the oil left in the formation after secondary recovery is a film of oil adhering to the sand. If some way could be found to remove this oil from the sand it would greatly improve the percentage of recovery.

a new

HIGH



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Many operators are doing research work on this problem, but much of such research is secretive. Some chemicals have been found that will cleanse the oil from the sand in laboratory tests, but when applied in the field they form a precipitate and clog the sand pores and for this reason cannot be used. Thus it resolves itself into a problem of finding a solvent for the oil or a substance for which oil is a solvent, to remove the oil from the sand grains. Peculiarly enough, the industry has had this commodity all of these years but has not used it. The substance is gasoline and the lighter hydrocarbons.

The efficacy of this can easily be demonstrated with clothes that have become oil soaked. Clear cold water or dry gas are not used to remove the oil. Gasoline or some of the lighter derivatives of oil are used, thus making a very light volatile oil. Some of this very volatile oil is left in the clothes and must be evaporated before the clothes are again ready for use.

The industry has overlooked the use of gasoline, which our wives could have told us about. Repressuring is normally done with dry gas, even building gasoline plants to extract all of the cleansing elements and using the residue gas for repressuring. In water flooding clear cold water is used and moves only such oil as is not adhering to the sand grains.

Gasoline Repressuring

If gasoline and the lighter hydrocarbons are mixed with oil we will have oil but a less-viscous oil which will flow more readily through the small interstices of an oil sand. Thus if the raw casing-head gas containing the gasoline and lighter hydrocarbons —commonly called wet gas—is reinjected without going through a gasoline plant, it will tend to cleanse the sand. To add to the effectiveness of this cleansing, raw unstabilized gasoline containing the higher hydrocarbons should be added. This, in turn, will cause the production of a richer casing-head gas which will be more effective in its cleansing. In this way all of the lighter fractions of oil will be retained for cleansing.

The quantity of gasoline to be used at the start and whether more gasoline should be later added will vary as the conditions in the different fields vary. Likewise it may be necessary to add additional gas to have a sufficient quantity for propulsion purposes.

It could well happen that after this method is used a short time the gravity of the oil will be above 40°. If this occurs a topping plant could be installed and the lighter fractions distilled and be reinjected into the sand.

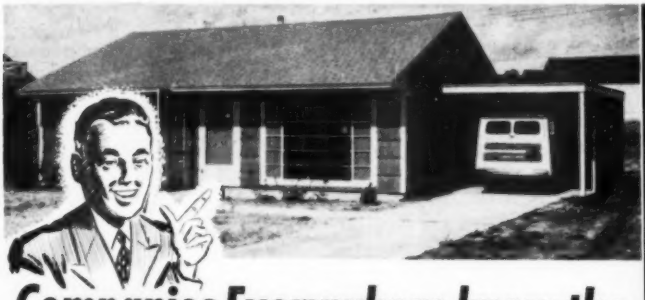
When all of the oil that is recoverable by this method has been recovered, the sand will be filled with a gas which is very rich with the lighter fractions of oil. This gas can be largely recovered by the use of a gasoline plant and reinjecting the residue gas to propel the rich gas. In some instances it may be desirable to add some additional gas. This can be determined only by experience, and it may be practical in some instances to recover this rich gas by displacing it with air.

This method not only should greatly increase the percentage of recoverable oil and thus add greatly to our reserves, which in turn would add to our national security, but it will also postpone indefinitely the time when it will be necessary for us to depend on synthetic products which are more costly than the natural product.

This suggestion is not entirely new or novel as it has been partially utilized in many instances. In each such instance the resultant recovered oil has been indicative of an enormous increase in recoverable oil if the process were carried to its logical conclusion.

It is reasonable to expect an ultimate recovery approaching 80 to 90 per cent of the original oil, if this method were carried to its logical conclusion.

This method would also create an enormous storage reserve of gasoline for emergency contingencies.



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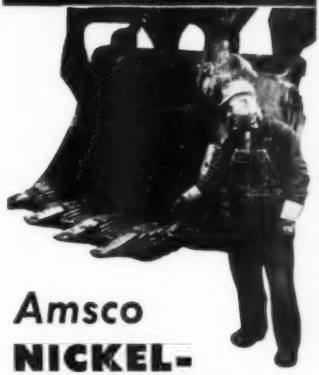

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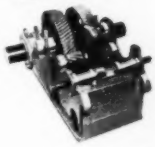

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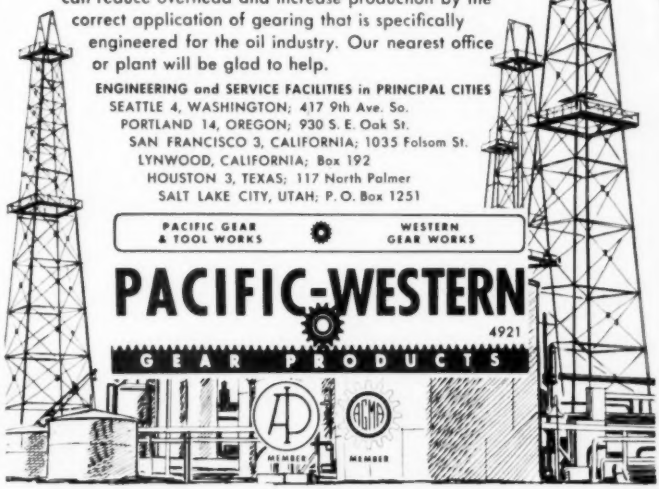

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Mechanical Vibration of Piping Induced by Gas-Pressure Pulsations

by Raymond C. Baird* and Ira C. Bechtold†

INDUSTRY employs many kinds of compressors in diverse ways for the general purpose of transmitting gases from place to place. Practically all compressors and their associated piping will show evidence of certain dynamic forces which are the result of the reciprocating action of the compressor cylinders. One of the most important of these is the presence of pulsative flow in the gas phase of the system. Accompanying these more or less rapid periodic variations in flow rate are corresponding periodic changes in pressure of the compressed fluid known as pressure pulses.

Some of the energy contained in such pulses which are propagated through pipes with approximately the speed of sound may be converted to physical vibration of piping, associated equipment, and supporting structures, depending upon the amplitudes and frequencies of the sinusoidal components making up the pulse wave shape. This conversion is due to the presence of mechanically resonant components in the piping and associated structures sympathetic to frequencies present in the pressure pulses.

Depending upon the complexity of the pulse wave shape and the extent and diversity of the piping network with its associated equipment, there is an extremely high probability of occurrence of similar pulse and mechanical resonance frequencies in a typical compressor installation. Thus very few compressor plants have been constructed, even when prior planning was involved toward minimizing pulsation, in which no vibration due to this cause resulted. In many cases such pulsation-induced vibration has been the limiting factor in the operation of petroleum-gas systems even to the extent of preventing design operating conditions to be reached.

Over a period of years, reliable theoretical formulas confirmed and tempered by empirical evidence have been developed for the sizing of pipes and supports for static stress conditions. These have been in the main quite reliable in the over-all sizing picture. However, in more cases than many design engineers like to admit, a system designed and built from the singular viewpoint of static forces may show a predilection to operate dangerously stress-wise when subjected to dynamic forces. In such instances gas piping, for example, can lend itself to such a degree of vibrational indulgence that at certain points in its structure the instantaneous stresses present may and often do produce fractures. The resulting hazard and economic loss may sometimes be considerable.

Fractures Still Occur

It may be argued that the original rule-of-thumb type of design data has been derived based upon an allowance for routine vibrational stresses. That may well be, but the fact remains that vibrationally produced fractures still do occur. Furthermore, if the design engineer is familiar with the probable amounts of vibrational stresses to be expected for a given piping arrangement, a considerable original cost saving might be effected by a more judicious oversizing of the system components.

The main objectives of this discussion are to describe the generation

*Research engineer and †director of research and development, Fluor Corp., Ltd., Los Angeles. Portion of paper presented at the American Society of Mechanical Engineers semiannual meeting, San Francisco, June 27-30.

Fig. 1—Definition of pressure pulsation. This is shown as the maximum pressure differential between adjacent peaks and troughs. Pulsation expressed in per cent = ΔP/P × 100

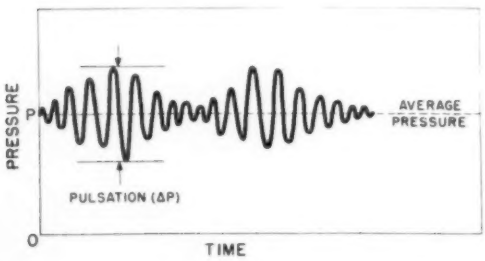
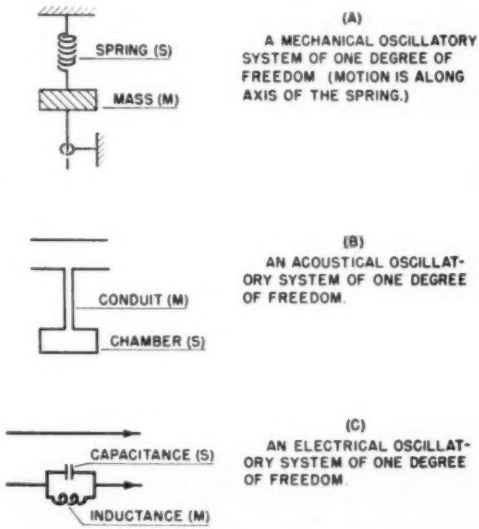


Fig. 2—Analogous mechanical, acoustical, and electrical systems of 1° of freedom. For simplicity the dissipative elements are not shown


SPRING (S)
MASS (M)
(A)
A MECHANICAL OSCILLATORY SYSTEM OF ONE DEGREE OF FREEDOM (MOTION IS ALONG AXIS OF THE SPRING.)
CONDUIT (M)
CHAMBER (S)
(B)
AN ACOUSTICAL OSCILLATORY SYSTEM OF ONE DEGREE OF FREEDOM.
CAPACITANCE (S)
INDUCTANCE (M)
(C)
AN ELECTRICAL OSCILLATORY SYSTEM OF ONE DEGREE OF FREEDOM.

and nature of gas pipe-line pressure pulsations, the means whereby they can produce mechanical vibration in pipes and associated structures, and the manner in which pulsations are propagated through a pipe line. No attempt will be made to show how they may be minimized or eliminated.[1,2]

Usual Energy Sources

Usual sources of energy for vibration of pipes and associated structures are:

1. Outside energy sources operating to produce vibration of a mechanical self-excited type. The humming of telephone wires in a wind is an example of this type.

2. Direct mechanical coupling to vibrating engines or supporting structures.

3. Pulse energy of gas flowing inside a pipe.

Sources 1 and 2 are often of major consideration in the vibrational picture. Source 3, nevertheless, is in many cases the most important factor and at the same time may be the least understood.

These are three principal ways in which pressure pulses can be produced and superimposed upon the mean static pressure of a gas flow system. These may be listed in order of importance as follows:

1. Compressor action in pressurizing the system for producing and maintaining gas flow.

2. Acoustical resonance effects of chambers and pipe lengths involved in the flow path.

3. Pressure variations produced by the bourdon-tube principle because of mechanical vibration of the piping.

Method 3 is of rare importance in gas-flow problems because of the compressibility of the gas and normal rigidity of piping which precludes anything but vanishingly small percentage change in volume by mechanically produced vibration.

Method 2 can be of considerable importance and actually often prevents the accurate measurement of the pulsation wave shape produced by compressor action because of its masking influence. As a matter of fact, when using reciprocating compressors it is practically impossible to segregate the effects of compressor valve action and piping resonance. In the case of rotary compressors, the latter could more readily be estimated or obtained experimentally, but since the use of the reciprocating compressor is far more common, the attention of this paper will be directed towards analyzing its effect in producing pulsative flow.

The resonance effects of piping and manifolding chambers can often produce economic loss in that they may alter the effective static pressure conditions at the juncture of compressor

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valve and piping so that a real and undesirable increase in engine-fuel consumption or horsepower requirement becomes necessary. This is a standing wave condition whereby the reflected pressure wave or pulsation produces an increase in the average pressure at the outlet of compressor cylinders at approximately the time that the valve opens to disgorge another compressed "slug" of gas into the line. As might be expected, the resulting erratic valve action may also be recognized by an increase in the rate of wear with consequent rise in valve-replacement costs.

In the discussion to follow, pulsation will be defined as the maximum differential pressure in pounds per square inch from peak to trough of the pressure variation. This definition is illustrated by means of Fig. 1, which, it will be noticed, looks much like the situation in the electrical analogy where an alternating current is superimposed upon a direct current flow. Indeed, in the electrical analogy a gas compressor may be regarded as a direct current generator producing a voltage carrying an appreciable "ripple" of complex wave form. Pulse amplitudes which are 10 per cent of the average line pressure are often obtained in practice and may be sometimes considerably greater than this. As a general rule, pulse amplitudes which are greater with respect to the average system pressure are usually found in the lower-pressure systems due probably to larger ratio of compressor-cylinder displacement to line size normally encountered there.

A reciprocating compressor produces a fundamental pulsation rate which with few exceptions can be computed by the following relationships:

1. For an even number of cylinders:

$$f_p = \frac{SN}{60} \qquad (1)$$

2. For an odd number of cylinders:

$$f_p = \frac{SNA}{60} \qquad (2)$$

where

f_p = pulse frequency in cp.
S = driveshaft speed in r.p.m.
N = number of cylinders
A = action of the compressor; 1 for single and 2 for double-acting.

A fundamental pulsation rate, f_p, does not necessarily mean that much energy is contained in the fundamental sine wave component of this frequency in the Fourrier analysis of the pulse wave shape. On the contrary, it has been found that oftentimes the second and even the third harmonic contain most of the pulse energy. However, because of acoustical and/or mechanical reaction on the pressure pulse by shock forces due to the sudden ejection or stoppage of the gas slug from the compressor cylinder, there usually results an alteration of the original wave shape by addition of surplus perturbations not harmonically related, to the extent that the resultant wave cannot be subjected to a Fourrier analysis for determination of its sinusoidal components. This fact has been confirmed by studies of actual pulsation traces and therefore it is difficult to tell accurately what percentage of the total pulse energy is contained in the fundamental pulse frequency f_p. The net pulse wave shape resulting from compressor action may be quite complex, depending on such factors as valve action, size and shape of suction "bottle," acoustical and mechanical reaction of associated piping, etc.

In many installations several compressors pump into the same discharge header. Under such conditions there will be a reaction between the fixed pulse patterns of the individual units due to nonsynchronous crankshaft speeds in which, theoretically, peak pulses equal to the algebraic

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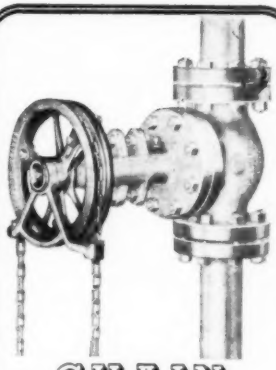

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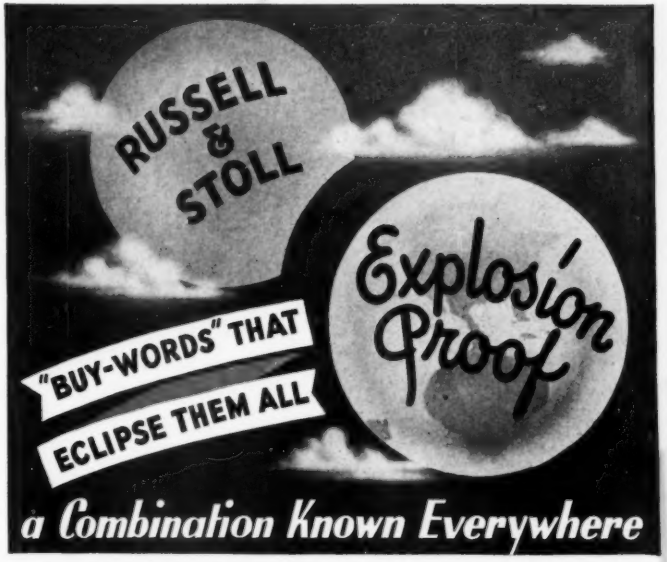

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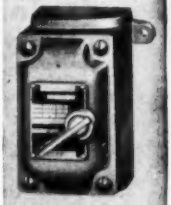
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sum of each compressor peak pulses may obtain aperiodically. Similarly, there may be short intervals of time in which pulsations are entirely absent because of relative compressor crankshaft phasing resulting in algebraic cancellation of their individual pulsation patterns.

To understand the phenomenon of mechanical vibration produced by pressure pulses in a pipe, a few remarks on the properties of vibrational systems are necessary.[1] As is well known, a close dynamical analogy exists between mechanical, acoustical, and electrical systems. Each of these systems contains three elements which have their counterparts in those of the other two systems. These three elements which may be used to describe the reaction of the three systems to dynamically exciting energy are:

1. The change-resistant element or the unit which stores kinetic energy.
2. The change-producing element or the unit which stores potential energy.
3. The dissipative element or the one which more or less slowly dissipates energy fed into the system in the form of heat and/or radiated energy.

Arrangement of Elements

The three elements for any one of the systems, mechanical, acoustical, or electrical, may be arranged so as to allow one or more degrees of freedom, that is, the complexity of the resultant circuit may require several equations to describe completely its dynamic characteristics, the number of equations required denoting the total number of degrees of freedom. This discussion is limited to simple oscillatory circuits of one degree of freedom. **Mechanically,** such a circuit may comprise a weight suspended through a spring from a fixed point, **acoustically,** a cavity side branch connected by means of a tube to a conduit passing sound energy, and **electrically,** an inductance in parallel with a condenser, the combination then connected in series with one lead of an electrical line. The three circuits are illustrated in Fig. 2.

Each of these circuits has a natural oscillatory frequency which is denoted its resonant frequency and which varies as the reciprocal of the square root of the product of the magnitudes of its "kinetic" and "potential" elements, the dissipative elements limiting the maximum amplitude of the oscillation. Thus, if the weight suspended by the spring is given an initial displacement from its rest position, it will oscillate up and down as a definite rate practically independent of the amplitude, blowing across the mouth of a bottle will produce a tone of pitch nearly independent of the exciting energy, and alternating current of a frequency resonant

to that of an "LC" series parallel circuit connected in the line will effectively be prevented from flowing onward due to electrical resonance. The latter may be recognized as the "wave trap" of early radio days.

Thus any collection of mechanical, acoustical, or electrical elements can be analyzed, the number of natural periods of resonance being a function of the total number of degrees of freedom it possesses. A piece of pipe, for example, fastened tightly at its ends, has its mass, compliance, and resistance distributed throughout its length and thus with many degrees of freedom can be excited at different frequencies, depending upon where along the length the exciting energy is applied.

With many vibrational frequencies possible, however, the one normally easiest to excite is the fundamental in which the center of the pipe moves up and down as a whole. From the stress standpoint, nevertheless, although such a vibration may look bad, actually in many cases the more unobtrusive higher-frequency vibrations may be the ones producing the most dangerous stresses. This may be seen easily as follows, assuming the motion of an elementary element of mass (Δm) to be sinusoidal and its position therefore capable of being expressed as:

$$s = A \sin \omega t \qquad (3)$$

where

- s = the displacement from rest position
- t = time
- A = the peak amplitude of displacement
- $\omega = \pi f$ where f is the frequency of vibration

the velocity of the mass is:

$$\frac{ds}{dt} = A \cos \omega t \qquad (4)$$

and its acceleration is:

$$\frac{d^2s}{dt^2} = -\omega^2 A \sin \omega t \qquad (5)$$

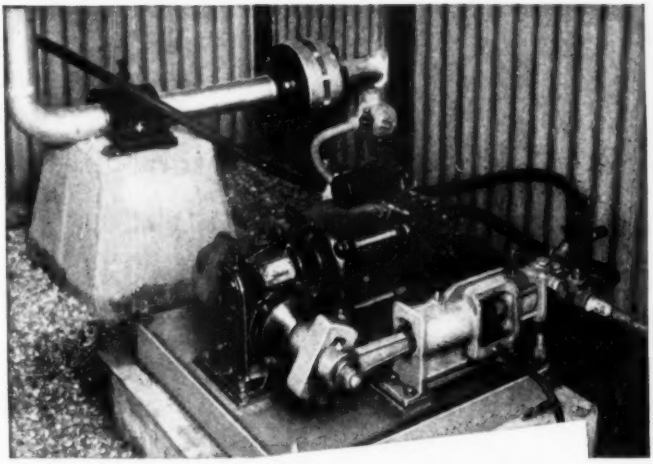
The force associated with this acceleration is:

$$F = -(\Delta m)\, \omega^2 A \sin \omega t \qquad (6)$$

and is directed toward the rest position of the element.

It is apparent, therefore, that vibrational stresses are a function of the square of the frequency as compared with the first power of the amplitude. Thus a structure vibrating at a high frequency but with a very small amplitude may actually be producing stresses far greater than one having low frequency and large amplitude oscillations.

In the case of the large pressure



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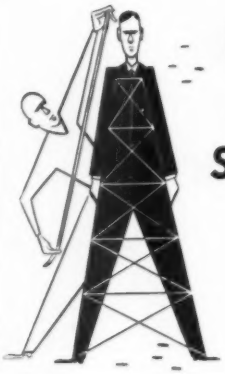

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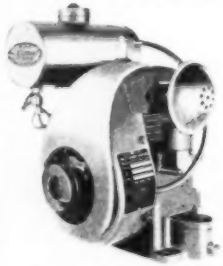

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vessels, piping, and structures employed in the petroleum industry fundamental resonant frequencies are often too low to be excited by the fundamental pulse energy (f_p) of high-pressure gas flow. Hence higher harmonics of the fundamental and/or spurious high frequencies present are usually the ones which pursuant to Equation 6 may produce high mechanical stresses. Further, as one goes to the heavier pressure vessels usually associated with higher pressures the dissipative element tends to become less proportionally to the other two thus allowing larger peak vibrational amplitudes to develop.[4] At the same time, the "potential" storing or stiffness element may increase more rapidly than the "kinetic" or mass element so that fundamental frequency of vibration increases.

This increase in f then results in increased stress forces in accordance with Equation 6. However, although f_p may be too high to excite fundamental vibration in large units such as gas cleaners, accumulators, open-section cooling coils, heat exchangers, building structures, structure and vessel foundations, and long pipe lines, vibration in this mode may yet result from pulsative flow. In such instances because of the high ratio of mass to compliance and/or damping coefficient dangerous stresses may develop even at sub-f_p frequencies. This phenomenon may come about because the fundamental resonant frequency is an exact submultiple of f_p. However, by far the most important reason is the presence of sympathetic beat frequencies as already described and illustrated, from manifolded non-synchronized compressors. This vibration-producing mechanism is subtle in production but sometimes devastating in effect and can manifest itself suddenly after a period of satisfactory operation (from a vibrational standpoint) due to a particular relationship in compressor speeds giving the requisite beat frequency.

The chief method, as already pointed out, by which pulse energy can

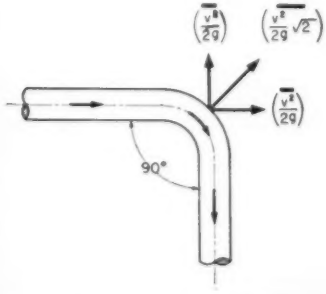

Fig. 3—Vector components of velocity head loss of flowing gas in a 90° directional change in piping

be converted to vibrational energy of the pipe carrying the flowing gas itself is through changes in the velocity-head loss in accordance with the pulsation wave shape. Supposing that there is constant smooth flow through the pipe of Fig. 3, there will be a velocity-head loss producing static forces equal to

$$\left(\frac{V^2}{2g}\right)$$

ft. of the flowing gas in each of two directions shown. The vector sum of these two forces is also shown and in this case equals

$$\left(\frac{V^2}{2g}\ 2^{1/2}\right)$$

Now, as long as this head-loss force is constant (no pulsation) the pipe will not vibrate even though loosely supported. Under pulsative flow conditions, on the other hand, the velocity-head force

$$\left(\frac{V^2}{2g}\ 2^{\pm\alpha}\right)$$

will vary correspondingly, thereby setting up a pulsating force acting directly on the pipe which will set the latter into vibration if it contains frequencies near to the natural frequency of vibration of the pipe itself.' The resultant vibrational amplitude and consequent internal stresses produced will depend as before, upon the pipe damping coefficient and the closeness of the exciting frequencies to the natural (or a harmonic) frequency of the pipe structure.

Two other means whereby pulsative flow can result in vibration are (1) viscous drag exerted by pipe walls on the gas stream and (2) the bourdon-type effect. Known simply as pipe-friction pressure loss (1) varies as the instantaneous gas velocity which in turn is controlled by the pressure pulse propagating through the section of the pipe in question. This effect gives rise to a varying pressure directed axially along the section of the pipe where it is produced.

The bourdon-type effect (2) can perhaps be best realized in long stretches of relatively unsupported pipe where the sag due to gravity results in imparting to it a noncircular cross-section. It should be noted that this mechanism as contrasted with the other two already described can be effective at very low rates of gas flow whereas the others become ineffective under this condition. However, it is believed that the vibration-producing mechanism chiefly responsible in vibration problems is the pulsation controlled velocity-head loss. It is thought, therefore, that even though techniques for measuring the relative effects of the three methods

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could perhaps be developed, vibration induced by the velocity-head effect would be found to far outweigh that due to the others.

To summarize the foregoing with regard to the manner in which pulsation energy results in mechanical vibration, some of the pulsation energy is converted to periodic physical force because of interaction between the gas and the pipe through which it is flowing. These periodic physical forces which usually have a complex wave often will contain component frequencies which lie close or are resonant to the mechanically resonant frequencies of the pipe and/or associated structures. The force stimulation necessary for mechanical vibration is thereby achieved.

Regarding the propagation of pressure pulses through a pipe line, it is believed that technically such cannot be considered as simply the propagation of sound waves in a gaseous medium even though such a simplification may be entirely within reason for certain engineering applications. The reason for this lies principally in the following two things:

1. Pulsation often reaches an appreciable per cent of the average system operating pressure as already pointed out.

2. There is a requirement for continuous gas displacement or positive unidirectional flow.

A picture which is believed to be somewhat nearer the truth in so far as pipe-line transmission is concerned has been experimentally indicated by J. W. M. DuMond et al.[5] He shows that the propagation of ballistic shock waves is accompanied by a frequency conversion effect whereby some of the energy of low frequency components is converted to high frequency in the pulsation pressure pattern. However, his work was done in the free atmosphere with unconfined spherical radiating waves, a case which coupled with no requirement for positive net flow of the conducting medium is obviously somewhat different from pulsative flow conditions in a pipe line.

There is evidence that a basic change in pulse wave form with distance of travel is present in pipe lines. This is based on observation of the variation in effectiveness with distance of pulsation removing devices downstream from the compressor. Perhaps the chief counteracting effect of a pipe line to the conversion of pulse energy to higher frequency components would lie in increased frictional forces exerted by the pipe wall tending to damp out the high frequency components in the pulse. This implies that frequency conversion of pipe-line pulsation would not be carried to the degree theoretically indicated and experimentally substantiated by DuMond for unconfined ballistic shock waves.

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Transcontinental Files Suit for Line Passage

Two additional expropriation suits were filed recently in Opelousas, La., by Transcontinental Gas Pipe Line Co. against property owners in the Melville section. Suits will be tried July 26 and 28 by Judge Lessley Gardiner.

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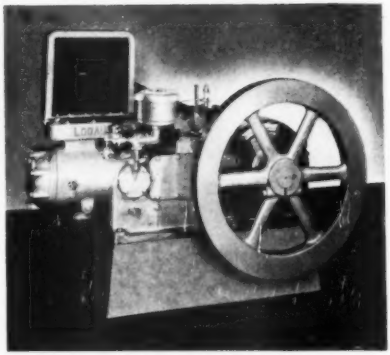

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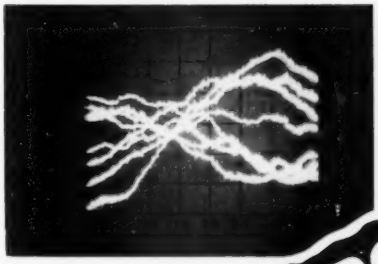

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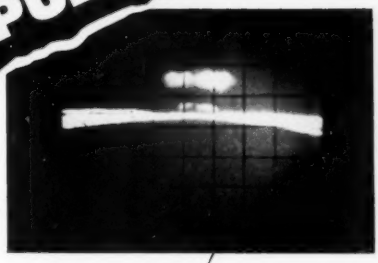

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Procedures—Benefits—Problems—of UNITIZATION

by C. B. Caruthers*

Introduction

UNITIZATION is becoming more and more important in oil operations. For example, Stanolind entered its first unit in 1930. During the next 10 years it became a party to two more unit agreements. In the last 9 years, however, it has joined in 35 additional units. I believe our increased interest in units is somewhat representative of the trend in the industry. As more and more oil producers and royalty owners realize the increased oil recoveries possible by unit operations, this trend should accelerate. This paper will discuss the over-all subject of unitization.

Definition of unitization.—I define unitization as: the act of combining separately owned interests and rights in certain lands and leases in a way that will allow development and production without regard to lease or property lines. A unit may cover everything from the surface down. On the other hand, it is possible to limit a unit to only oil or gas produced from specific formations. Sometimes operating arrangements among owners of working interest only are called units, but this paper will include only those which involve both the royalty and working interest.

Types of unitization.—As I see it there are only two general types of units. The first is the spacing unit, where small leases or undivided interests are combined to form an area conforming to the established spacing pattern for the field. These small units are formed for the purpose of drilling and producing only one well.

The second is the field-wide unit where separately owned interests in the productive area of one or more reservoirs are integrated. Although spacing units are of great importance and essential in oil and gas operations, the larger field-wide units are of the most importance. Comments on field-wide units apply in a general way to spacing units since the primary purposes of both are the same.

*Unitization superintendent, Stanolind Oil & Gas Co., Tulsa.

Basic Purposes of Unitization

The basic purposes of any unitization are:

1. To minimize waste.
2. To increase ultimate recovery.
3. To protect the correlative rights of the owners in the common reservoir; that is, the right of each owner to produce or receive his just and equitable share of the production from the reservoir.

If these basic purposes can be accomplished to a maximum under ordinary lease operations then there is no justification for the formation of a unit. I believe that accomplishment of these three purposes will meet the fundamental requirements of any state or federal unitization law or regulation. As a practical matter, the program to be conducted must be economically feasible if it is to be given serious consideration.

Method of Unitization

There are two general ways of forming a unit. One, commonly referred to as voluntary, is by mutual consent of all or a substantial majority of the interested parties. The other, sometimes called compulsory, is by the application of state statutes where available.

Under the voluntary method, a unitization agreement is circulated for signature of the royalty and working interest owners. The unitization agreement is filed on record as notice to the public that the unit has been formed. Some leases give the working-interest owner the option of forming a unit at his election. In such cases the working-interest owners may file a declaration of record, and thereby form the unit without further consulting the royalty owners. It is only in rare instances that the lease grants the right to form a unit of an area larger than a spacing unit, so unitization agreements are almost always required when forming voluntary field-wide units.

Compulsory Unitization

Where field-wide units are formed by the application of state laws, the procedure set out in the statutes governs. Ordinarily, the unit becomes effective after proper application, notice, public hearing, and finding of the state regulatory body involved that the plan is a proper one. The statutes in some instances provide for the minimum percentage of ownership that must approve the plan before it will be considered. In other states these requirements are left solely to the discretion of the regulatory body in charge.

The states of Alabama, Florida, Georgia, and Oklahoma have so-called compulsory unitization laws applicable to field-wide units and covering both oil and gas. Louisiana has a statute which provides for compulsory unitization of gas pools for cycling purposes. The state regulatory bodies in Arizona and Illinois can compel the unitization of state lands. Several other states, including Arkansas, Michigan, Mississippi, and New Mexico have compulsory unitization laws applicable to spacing units.

The Oklahoma field-wide statutes along this line have probably received more publicity than those of any other state. In Oklahoma, the owners of 50 per cent or more of the working interest in the area proposed for unitization, computed on a surface-acreage basis, must join in the initial application to the Corporation Commission for a unit plan of operation. If the commission finds that the plan is fair and proper, it will issue an order approving the plan. This order becomes effective within 60 days, unless owners of 15 per cent or more

of the working interest file a written protest.

Written protest by 15 per cent or more will vacate the order of the commission. If the order is not protested and becomes effective, all working interests and all royalty interests in the unit area are unitized. It will be noted that the unusual feature of this procedure is that it is not necessary for the royalty owners to sign anything approving the unit. However, the royalty owners and all other interested parties do have ample opportunity to appear at the public hearing held by the commission on the application and to support or oppose the application as they see fit.

On the other hand, in Louisiana, the commissioner is authorized, after notice and upon hearing, to determine the feasibility of a field-wide unit covering gas-cycling operations. This would seem to authorize the commissioner to proceed on his own motion in a proper case without the need of obtaining the consent of either working-interest or royalty-interest owners. However, in practically all instances, the consent of the majority of the working and royalty-interest owners has been obtained prior to the filing of an application for a field-wide unit covering gas-cycling operations in Louisiana.

There are probably some very good arguments both for and against compulsory unitization. My over-all feeling on the subject is that before a unit is formed by application of state statutes, a substantial percentage of the royalty and working-interest owners should be in favor of the plan. On the other hand, owners of a minority interest should not be allowed to block a unit agreement that (beyond a reasonable doubt) will increase recoveries, promote conservation, and protect the rights of all parties involved. There is a definite need in most oil-producing states for compulsory field-wide unitization statutes. There is no doubt in my mind that many additional units of a highly desirable nature would be in operation today if adequate statutes were on the books.

The federal Government has been a strong advocate of unitization of federal lands since the early '30s. Since that time, some 275 units involving federal lands have been approved by the Secretary of Interior. Many valuable deposits of oil and gas have been discovered and are being developed within these units.

General Procedure

Here are some of the fundamental steps in building a field-wide unit:

1. All of the geological and engineering information on the area must be thoroughly analyzed. If this analysis shows waste can be minimized, ultimate recovery can be increased, and correlative rights can be protected directly or indirectly as the result of unitization, then unitization should be attempted.

2. Having decided to unitize, the applicable state and federal laws, rules, and regulations must be examined. This examination will reveal the type of plan and form of application required. In this connection, you should remember that the Department of Interior has rather specific and detailed rules and regulations where federal lands are involved.

3. Working-interest owners then must agree on these things:

(a). The area to be included, usually referred to as the unit area.

(b). The formations and substances to be unitized.

(c). The designation of a unit operator.

(d). The powers of the unit operator.

(e). Method of controlling operation of the unit and actions of the unit operator.

(f). Method of allocating unitized substances.

(g). The manner in which costs and expenses are to be borne.

(h). How investment in existing wells, equipment, and facilities will be adjusted.

(i). The method of handling title examinations.

(j). The accounting procedure which is to govern.

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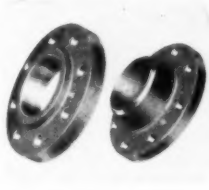

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(k). How the unit area is to be enlarged or contracted.

(l). The term or life of the unit.

(m). Any other requisitions peculiar to the project.

4. Agreements incorporating all of the legal and operating features to the satisfaction of all parties and interest must be prepared.

5. The agreements must be approved by sufficient parties and regulatory agencies to permit effective unit operations in accordance with the terms of the agreements.

Benefits of Unitization

We should now consider some of the benefits possible as the result of unitization:

1. Any proper plan of unitization is definitely in the public interest. Petroleum is an exhaustible natural resource and each barrel of additional oil recovered, as the result of better operating practices possible with unitization, is the equivalent of a barrel of oil discovered. This is particularly significant because new reserves are becoming harder and harder to find. It is the duty of the oil operators to recover every possible barrel of oil from the sources now proved.

2. A proper unit plan will benefit the interested parties in some and possibly all of the following ways:

(a). All development and operations within the unit area may be conducted without regard to lease and property lines which means that:

(1). Controlled pressure-decline or secondary-recovery programs involving the injection of water, gas, or other extraneous fluids may be inaugurated so that substantial increases in ultimate recovery will result. This is considered the major advantage of unitization because many increased-recovery projects are impractical or inefficient on a lease basis.

(2). Wells drilled after the effective date of a unit may be located at the most favorable structural positions where they will make a maximum contribution to ultimate recovery.

(3). The drilling of wells that will not contribute to the ultimate recovery may be eliminated.

(4). The natural energy contained in the reservoir may be used to the very best advantage. For example, wells which produce inefficiently because of high gas-oil or water-oil ratios may be shut in and production taken from more efficient producers.

(5). Investment in lease and other surface equipment and operating expenses may be reduced by the consolidation of lease and other facilities and by having only one field organization. Another reduction in operating expenses may be accomplished by delaying or entirely eliminating the necessity for artificial-lift equipment, as the result of maintaining reservoir pressure.

(6). Accounting costs of both the

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operator and nonoperator are reduced by the use of a summary form billing covering the entire operation instead of handling the accounting for each separate lease in the unit.

(b). Usually all oil and gas is collected and utilized either through sales or by injunction to the end that maximum economic return is realized by all parties. This means that wasteful practices, such as gas flaring, may be discontinued.

(c). In some states gas-oil ratio penalties may be eliminated or greatly reduced by injecting the casinghead gas back into the reservoir. This results in higher allowables and allows the oil to be recovered in a more efficient manner. In certain states, particularly in Texas, injection of gas may prevent oil properties from being shut down entirely. I assume that gas injection would not be feasible on a lease basis, so credit these benefits to unitization.

(d). Cycling of wet-gas reservoirs, not usually feasible without unitization, results in recovery of the liquid hydrocarbons in a more efficient manner and usually at an increased rate. In cases where there is a possibility that some of the liquids would drop out in the reservoir and become unrecoverable if the pressures were allowed to decline, the increased recovery as the result of maintaining pressure may be appreciable.

(e). The operation of a unit by one operator permits the assembling of complete geological and engineering information. This makes it possible to operate the unit much more efficiently than if each lease were operated on the basis of its lease information only.

(f). Each working interest and royalty owner participates in production for the entire life of the unit, regardless of when the particular lease he contributed to the unit ceases to produce. This means that in addition to other benefits, each owner is assured of an income until the reservoir is depleted.

(g). Certain additional advantages result from including federal lands in units. For example,

(1). Such lands are eliminated from acreage charges against their working interest owners.

(2). Term leases are perpetuated for the life of the unit.

(3). A new discovery, after the effective date of the unit, entitles the working interest owners to a straight 12½ per cent royalty rate even though the federal lease may provide for a higher rate.

The royalty owners may contend that some of the above advantages benefit only the working-interest owners; however, anything that benefits the working-interest owners will, I feel, also benefit the royalty owners. The reason for this is that savings to the working-interest owner will allow economic operations to a lower producing rate. This in turn

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will result in greater ultimate recovery and a greater total income to the royalty owner. Unitization should be particularly attractive to the royalty owner because he doesn't have to pay any of the additional costs. In other words, the working-interest owners put up all of the money and take all of the chances. If the program is successful, the royalty owners get a share of the increased recovery. If the working-interest owners make a mistake, it still doesn't cost the royalty owners anything.

Problems of Unitization

One may say that the advantages of unitization sound all right—but what about some of the objections raised by royalty and working-interest owners who are not sold on this method of operation? To mention some of the problems frequently encountered, and to attempt to present some ideas to use in overcoming these problems:

1. A general lack of knowledge of unit plan of operation is probably the largest single obstacle found. In other words, many working-interest owners and a majority of the royalty owners just don't know what you are talking about. This situation prevails in spite of the fact that the theory of unitization was advanced some 35 years ago, and some unit projects have been in operation over 20 years.

Overcoming this condition is the job of the people promoting a unit plan. If you are trying to unitize an area, you must take the time and trouble to develop a complete and simple explanation of what you are proposing and how it will effect everybody concerned. The landman, or whoever is to take the agreements around for signature, must understand the program well enough to explain it to those he will ask to sign.

2. One of the largest hurdles in negotiating a unit is the basis of participation. The basis of participation determines how each party will share in unit production. This is where "protection of correlative rights" comes into play. If the working-interest owners can agree on participation they can usually agree on the other features without very much trouble.

Difficulty in agreeing on participation will result if the negotiators assume a highly technical attitude. In other words, the negotiators must recognize the necessity of compromising various interpretations as to the relative value of tracts before progress can be made. In some cases, a negotiator will use the fact that his properties are essential to the success of the program in an effort to obtain a participation greater than that to which he is entitled. Such an attitude may prevent the honest approach to participation that is necessary.

The working-interest owners must never lose sight of the fact that the interest (correlative rights) of each royalty owner must likewise be pro-

tected in unit negotiations. About the only solution to these problems of participation is to try to prevail upon the negotiators to be fair and open minded in solving the problem.

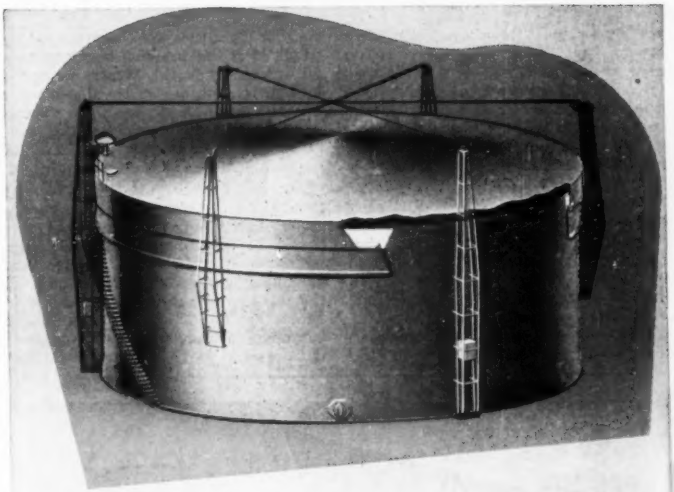
3. You sometimes encounter persons who are not necessarily against unitization, but who do not believe the method of operation to be followed under unitization will result in increased recoveries. This attitude usually represents an honest difference of opinion.

The best means of showing the probable benefits of the proposed operation is to show the results of a similar program which has proved successful in a comparable field. If information of this type is not available, it is necessary to rely on theoretical reservoir calculations. Both high and low-pressure injection projects are becoming more numerous and it shouldn't be long before we can point to successful projects in nearly all areas.

4. Some states have either inadequate or no unitization laws, which sometimes provides a serious obstacle to unitization. For example, Texas' statutes are silent on unitization for oil, except that state lands may not be so unitized. This simply means that unitization of state lands in Texas for the production of oil is out of the question. Without going into detail it is considered sufficient to say that with three or four exceptions, state statutes regarding unitization leave much to be desired. The problem of adequate state statutes is one for the respective legislative bodies to handle.

It is encouraging to note that in most oil-producing states, these bodies are making an effort to provide proper unitization laws. In Texas, for example, the legislature now has under consideration the Moffett unitization bill, which if approved will adequately take care of this situation. Of considerable benefit along this line is the work being done by oil industry organizations such as the Section of Mineral Law of the American Bar Association and the Interstate Oil Compact Commission. Recognition is also due those state senators and representatives who recognize the problem and are attempting to do something about it.

5. You frequently hear working-interest owners say they are afraid a unit organization will be classed as an association and thus taxable as a corporation. This objection can be overcome if the joint operating agreement is properly written. The Bureau of Internal Revenue has recently issued rulings on joint operating agreements (IT 3930 and IT 3933) regarding the association angle. These rulings, now being clarified and adopted, will make it possible to prepare joint operating agreements so as to practically eliminate any possibility of taxation as a corporation. Right now it appears that if each party has the right to take in kind



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and to individually market his share of unitized substances there is no danger of double taxation.

6. Working-interest owners sometimes decline to join in a unit for fear that damages will be awarded royalty or working-interest owners who do not join. Such liabilities are definitely minimized if all parties are initially offered an opportunity to join in the unit on a fair and equitable basis.

Another protection is that in forming voluntary units is it necessary to get a very high percentage of all interest owners to join before the plan can operate efficiently. This leaves only a small percentage of unsigned interest owners and the possible liabilities are correspondingly small. It is the practice of practically all working-interest owners to settle with their nonjoining royalty owners on a lease basis. In those states where the statutes provied for compulsory unitization the possibility of such damages is further reduced.

7. Some working-interest owners feel that they can operate their properties better than a unit operator could. This feeling can be overcome in some instances by letting that particular party operate the unit. If this arrangement isn't practical it is necessary to enumerate the many beneficial services the unit operator will render at a nominal cost. Examples of units operating successfully may also prove convincing.

8. Working-interest owners occasionally question each others' motives. This is particularly true where one operator owns a substantial portion of the area to be unitized. In this situation the job of demonstrating the fairness of the plan falls to the working-interest owner promoting the unit. Complete information presented in a clear and understandable manner will do much to eliminate suspicion. Actually there is no incentive for the promoting parties to withhold any pertinent information if the project is open and above board.

Future of Unitization

The theme of this discussion has been that the largest task facing us in future unitization efforts is one of education. It is a lot of trouble to explain how unitization works to the large number of parties ordinarily involved in an operation of this type. On the other hand, I believe the expected benefits in the form of increased recovery and the conservation of natural resources far outweigh the work involved.

As mentioned earlier, it is with increased difficulty that new reserves are being found. It is not only the desire but the duty of oil operators to conserve and recover every possible barrel of oil which has already been discovered. I believe unitization not only can but will play an important role in achieving these goals.

By way of summary, it appears the rate of increase in the number of unit operations will depend primarily on (1) how fast working and royalty interest owners can be educated as to the advantages of units, (2) how successful the operations of completed units prove to be, and (3) the rapidity with which states adopt adequate unitization laws.

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UNUSUAL ENGINEERING AND DESIGN PROBLEMS

POSED IN BUILDING Tapline

by S. P. Johnson*

THE main problem of construction which distinguishes the Trans-Arabian pipe line from a similar project in the United States is, of course, the remote location and the very large supporting organization that had to be organized to back up the actual construction staff. Some of the engineering problems, however, are also somewhat unusual.

The Trans-Arabian line was first considered as a probable future venture several years before the war. Serious thought to its immediate construction, however, started in the latter part of 1943 when the U. S. Government considered the construction of such a line as a war measure. Little was known about the character of the country at that time, and it was not known whether it would be more desirable to terminate in Palestine, perhaps at Haifa where one branch of the Iraq Petroleum Co. line terminates, or to adopt the somewhat longer route into Egypt.

After a reconnaissance at the end of 1944, The Texas Co. and Standard Oil Co. of California engineers recommended a route which, to all intents and purposes, is that indicated in Fig. 1 and is the route that is now being followed in the construction of the line. Later on a route into Egypt was also examined critically, but was not favored because of its great length and the much greater difficulties of terrain. Surveyed distance on the present route is 1,067.5 statute miles.

When the design of the pipe line was reexamined in 1945 at the close of the war, it became clear that 24-in. pipe as planned originally was too small for best economy. For a nominal average flow rate of 300,000 bbl. per day (with some allowance for lost time) a thin-wall pipe of approximately 30-in. diameter was believed preferable. It was hoped such

*Engineer, Standard Oil Co. of California, San Francisco. Portion of paper presented at the semiannual meeting, American Society of Mechanical Engineers, San Francisco, June 27-30, 1949.

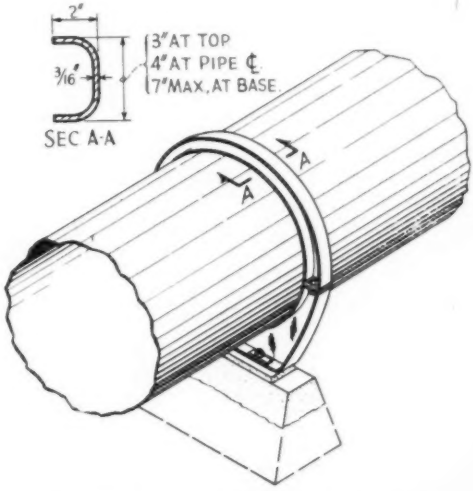

Fig. 1—(Left) Route being followed in constructing the Trans-Arabian Pipe Line from Abqaiq to Sidon. Fig. 2—(Right) Method of supporting pipe in places in the rock plains where rock is close to surface

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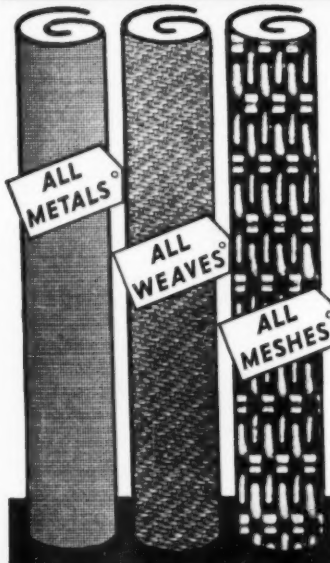

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pipe could be obtained after the war. Actually, the procurement of pipe turned out to be very difficult.

The pipe that is being used seems to be very satisfactory, and is believed to represent a good solution to the problem. This pipe has been, and still is being manufactured at Maywood, Calif., from plate rolled at Geneva, Utah. Half the pipe is 30 in. and half 31 in. in diameter, and most of it has a nominal wall thickness of ¼ in. The steel is a medium-carbon, medium high-manganese material and is semikilled.

When the plate arrives at Maywood it is planed to size, rolled, and welded inside and out by the Union-Melt process. As fabricated the pipe is about ½ in. undersize in diameter. After fabrication it is put into a heavy steel die and expanded to full size under hydraulic pressure. This expansion of course stretches the steel beyond the yield point, and this cold working makes a significant increase in the tensile strength, especially in the circumferential direction.

The specifications call for the pipe to have a minimum circumferential yield strength of 52,000 psi. and an ultimate strength of 65,000 psi. after expansion. Both of these values are consistently exceeded and most of the material shows a yield strength over 60,000 psi. The expansion apparently causes a gain in yield strength of between 12,000 and 20,000 psi. in the circumferential direction, and perhaps half as much in the axial direction. The cold working also increases the ultimate strength of the metal in the circumferential direction by as much as 3,000 to 7,000 psi.

After being expanded, the pipe is tested hydrostatically to 90 per cent of the minimum specified yield strength of 52,000 psi. Very few failures result on this final test, but it is still interesting to note that some failures do occur. Even after the pipe has been stretched beyond the yield point during manufacture, pieces still occasionally fail at only 90 per cent of this pressure, or, in fact, somewhat less. A few failures also have been experienced in the field. One failure was rather spectacular and will be referred to later.

The reason for making half the pipe 30-in. and half 31-in. was to permit it to be telescoped to reduce shipping charges. It is impossible to load a cargo ship to more than a third its deadweight carrying capacity with large, thin-wall pipe. There was some consideration of telescoping three deep, but the complications seemed too great. In the beginning there were many who questioned whether a nominal difference of only an inch would be sufficient to permit easy nesting and denesting. It has proved to be sufficient, but another half-inch clearance would have facilitated de-

nesting, and avoided some scoring of the pipe.

The design basis for the pipe line was taken as 65 per cent of the nominal yield point based on nominal thickness, stress being computed by the conventional outside-diameter or Barlow formula. Such a procedure gives an allowable working pressure of approximately 750 psi. for 30-in. pipe having a nominal ¼-in. wall thickness.

When the pipe line was laid out on the basis of a minimum flow of 315,000 bbl. per operating day (300,000 bbl. per average day) and ¼-in. wall thickness, it was found that at least eight pumping stations would be required, but by increasing the wall thickness of the pipe at the high-pressure part of the line to a maximum of $\frac{7}{16}$ in. the working pressure could be increased to 885 psi., and by this move it was possible to reduce the number of stations to six.

The northern plains of Arabia slope gently upward from east to west at a fairly uniform rate, reaching a summit in Trans-Jordan only a little more than 100 miles from the Mediterranean Coast. The maximum elevation of the pipe line is nearly 2,900 ft. at Milepost 785, but the controlling elevation for the line originally laid out was only about 2,200 ft. and was at about Milepost 1025.

At approximately Milepost 1032 the right-of-way plunges precipitously into a valley some 13 miles north of Lake Hula, descending to an elevation of 740 ft. at Milepost 1042. This valley is the northern extension of the Jordan River drainage. From here the route crosses a spur of hills, reaching an elevation of 1,600 ft. 5 miles from the valley floor, and descends to 700-ft. elevation at Milepost 1052.

The pipe line climbs to an elevation of 1,700 ft. across the southernmost spur of the Lebanese Mountains, descending over 1,000 ft. to the terminal in the last 4 miles. There is obviously an excess of pressure to be used up in this section, and it was deemed necessary for safety to have the pipe line capable of withstanding the maximum hill pressure (some 2,500 ft.) under static conditions.

Although the pipe line was designed for six pumping stations, it began to appear (well after construction had actually started) that a larger capacity than 300,000 bbl. per day might be badly wanted, and, further, that obtaining more steel pipe for looping the original line would probably be all but impossible during the next 2 years if the steel shortage continued. Only a few months ago, therefore, the heavy and light pipe was reallocated so as to permit the addition of intermediate pumping stations which would raise the ultimate total number of pumping stations. This results in some unbalance when the line is operated with six

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stations, and also results in cutting the pressure of several of the first six stations below the original design limit.

As it stands now, the line will have a total capacity of 315,000 bbl. per actual operating day with six stations and slightly over 500,000 bbl. if the intermediate stations are added.

From a standpoint of pipe-line construction, the terrain encountered can be classified as follows:

1. Moving dunes.
2. Sabkhas (salt bogs).
3. Dikaka, stable sand with small bushes.
4. Gravel plains.
5. Rocky plains or plains with rock at varying distances below the relatively flat surface.
6. Lava beds.
7. More or less cultivated land near the Mediterranean, much of it being rocky hills.

While only the westernmost part of the terrain is mountainous in the sense usually understood, some of it has prompted design features that have not usually been in the construction of oil pipe lines. Where the line crosses moving dunes it has, in general, been buried. Of course the dunes were avoided as far as possible, and a good deal of work was done in moving sand to put the pipe in as stable a situation as possible, but it will have to be watched and perhaps readjusted as the sand moves.

Across sabkhas the line is supported on steel piles. The piles have I-beam caps, and the pipe is held in pressed-steel ring girders. Across stable dikaka the pipe line is and will be buried. It will also be buried across the gravel plains where reasonable excavation by ditching machine is possible. Across rock plains three different methods of construction will be used, depending on the depth of the rock below the surface.

Where the rock is deep enough to permit the line to be buried, this construction will probably be used in most cases. Where the rock is on the order of 2 ft. below the surface, it is proposed to lay the pipe on a well-padded support after excavating down as far as the rock, and then to mound up soil over the line to hold it in place. This second type of construction will not suffice to anchor the line, and at horizontal changes in direction or vertical overbends an anchorage will have to be provided. Where the rock is close to or on the surface the line will be supported a few inches above the ground at intervals of 20 m. (about 66 ft.) in pressed-steel ring girders supported on small concrete pads. (Fig. 2.)

Aboveground Construction

The aboveground construction is of principal technical interest since the other types of pipe-line construction are well understood. As far as the supports are concerned, after quite a bit of study of the secondary stresses at supports it became evident that it would be necessary to reinforce the pipe at these points in some manner, and pressed-steel ring girders, as indicated in Fig. 2, were selected as the most economical method of reinforcement, being light and, in large quantities, fairly inexpensive. Static bending movements are maximum at the supports, but are only moderate at a 66-ft. spacing.

A second problem was that of temperature. Expansion joints were considered virtually out of the question. Expansion loops were considered, and, in fact, had been used in smaller lines of Arabia and elsewhere. They are very expensive in such large-size pipe, and increase the length by several per cent besides introducing extra fluid friction. Moreover, careful analysis, including frictional effects, shows that they do not reduce the net temperature stress in a large line unless spaced very close together. A still further objection to such expansion provisions is that each one of the ring-girder supports would not only have a sliding plate or equivalent

(Continued on page 319)

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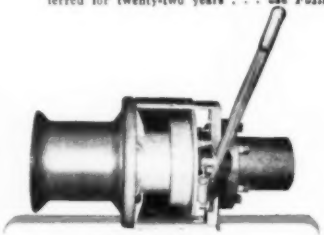

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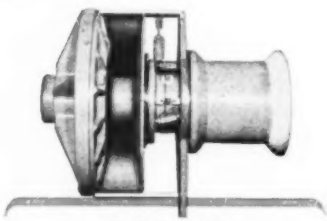

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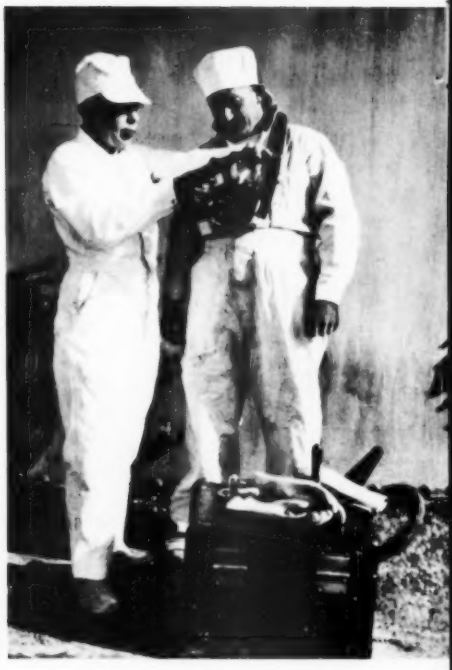

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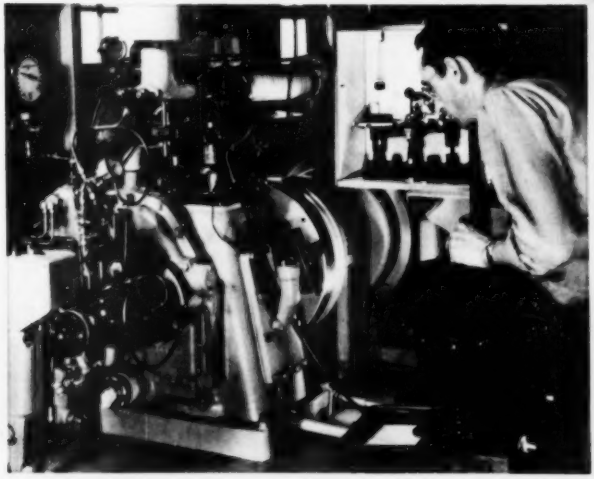

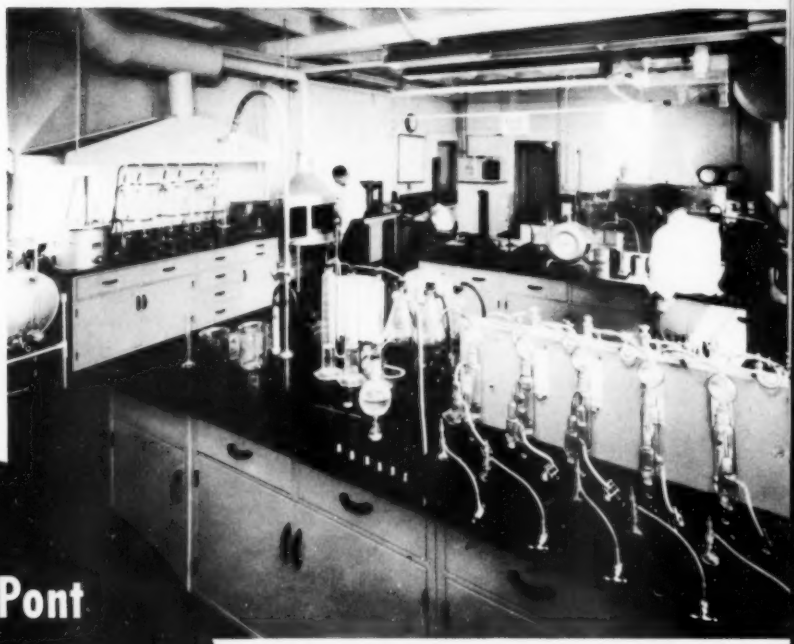

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on its foundation, but would also have to be guided laterally.

Still another method of construction considered was that of laying the line in a zig-zag fashion so that it can increase or decrease its length by moving laterally. This type of construction has been used successfully by Anglo-Iranian Oil Co. on small lines for a considerable period of time, and was also used on the land sections of the 12-in. line which was laid between the east coast of Arabia and the refinery on Bahrein.

The zig-zag construction is fairly easy to accomplish in the case of a small line not requiring reinforcement at the supports, but in the case of a large line it would introduce serious secondary stresses and mechanical problems. A large line of thin-wall section has much more deadweight per foot in comparison to the amount of metal than a small line, and hence friction on supports is so magnified as to make expansion provisions comparatively ineffective unless expensive antifriction supports are employed.

A careful study based on these considerations indicated that the pipe line would be under no more net stress if no attempt was made to permit expansion and contraction, but if, instead, it was simply held rigidly in place, of course being suitably anchored at changes in direction. In this study it was assumed that the pipe might reach a temperature 30° higher than the atmosphere, or, in other words, a maximum of 140° F. (The first part of the line will be operated at 160° F. maximum, the hot oil coming from a crude-oil stabilizer.)

The temperature of installation was assumed to average 80° or 90°—less during winter—and the minimum temperature reached by the flowing oil probably not less than 40°, although atmospheric temperatures in western Arabia often go below freezing. In other words, it was necessary to figure on a range of about 100° in temperature, perhaps two-thirds or more of which might be in one direction.

Every degree change in the temperature of a completely restrained piece of steel results in an axial stress of approximately 190 psi., so 70° would result in an axial stress of about 14,000 psi. which, it was believed, was not excessive in view of the fact that the circumferential tensile stresses were more than double this amount. Of course the column stability of the line on supports at 66 ft. was verified.

In addition to the axial stress due to temperature, there is also that due to internal fluid pressure. The latter is tension and amounts to 30 per cent of the circumferential stress instead of the 50 per cent that would be with a free-floating line closed at the ends. This tension tends to offset the

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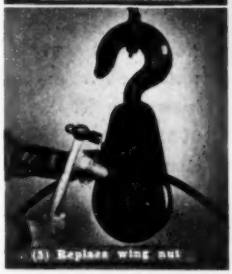

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compressive stresses due to rise in temperature in the more highly stressed portion of the line, and it appeared to the designers that it would, if anything, be helpful.

There was a good deal of discussion regarding the calculation of the effect of combined stresses by the maximum-shear theory of elastic failure. The latter was discarded (or at least ignored) since there did not seem to be any evident mechanism by which a complete failure in shear could take place in a structure of this kind, nor any probability that shear at an angle to the axis when the pipe was in compression could operate to induce a premature failure of either the longitudinal or circumferential welds. This, however, is a question where discussion would be very welcome.

The two types of failure ordinarily encountered in a pipe line are rupture of the longitudinal weld almost invariably as the result of inherent defects or, second, having the line pull apart as the result of tension of circumferential welds made in the field. The latter type of failure would not, of course, be expected when the line was in compression.

Still another problem considered was vibration caused by the wind. The Karman effect for isolated structures removed from sources of interference whereby eddies detach themselves alternately from two sides of the cylinder was considered, but no conclusion could be drawn since there appeared to be no available information whatever concerning the Karman effect on a cylinder laid horizontally and relatively close to the ground.

Up to now the line has shown some vibration, but the deflections have amounted to no more than about ½ in., by actual measurement. There has been no evidence of resonance at any wind velocity so far encountered, but there has been some evidence that the line goes into free vibrations of fairly small amplitude at its natural frequency at certain times, perhaps after receiving a shock excitation from gusty or variable wind.

During the hydrostatic field test of the part of the line laid aboveground a failure occurred which may be of general interest. During hydrostatic testing of the first section in 1948 one of the longitudinal seams opened up for a distance of some 3 ft., evidently releasing the pressure almost instantaneously. The pressure was 730 psi. and the stress 84 per cent of the nominal yield point. The line in this long continuous straight section was laid on two-pile bents with I-beam caps under the ring-girder supports.

Theories on Pipe Movement

About a mile of the line moved axially on each side of the break for various distances estimated to be as great as 12 in., severely damaging the pile caps and ring girders of many of the supports. The movement was much larger on one side of the break than the other, and was away from the break. Web stiffeners for the pile caps, which had been included in the design, had not yet been installed, and their absence probably contributed to the extent of the failure.

Several theories have been advanced to explain the movement of the pipe resulting from the rupture. It is known that this section of line had been under conditions of unusually severe and variable locked-up stress as the result of having one long section installed under temperature conditions widely different from adjacent sections.

The first theory, which is still regarded as probable, was based on the presumption that friction on the supports was sufficient to prevent equalization of the locked-up stresses until the shock wave caused by the break provided a force sufficiently great to break loose the static frictional resistance of the supports and largely to equalize the axial stress in the pipe. This theory, however, does not of itself explain why the pipe moved away from the break on both sides with no apparent axial movement at the point of failure. At least a part

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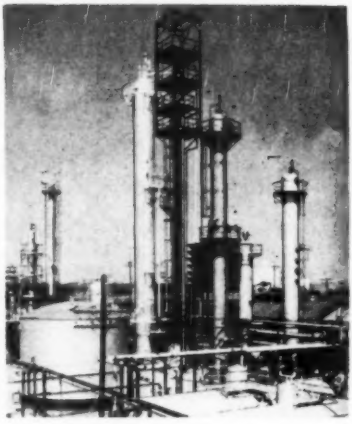

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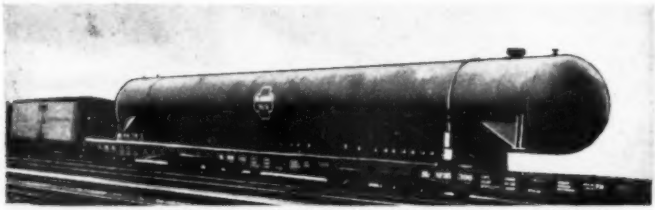

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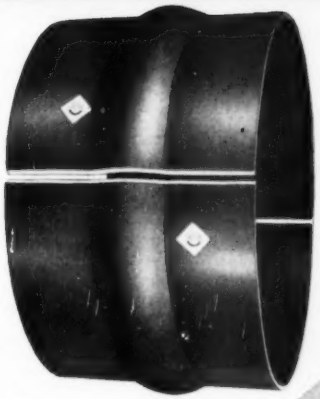

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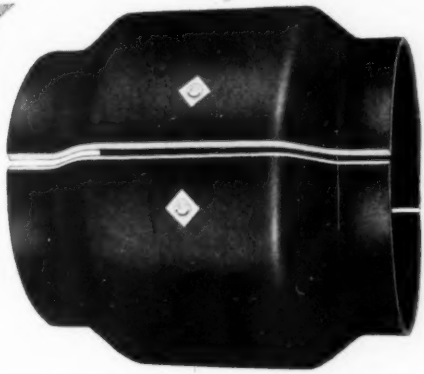

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of this movement can perhaps be accounted for by the sudden drop of longitudinal tension accompanying the sudden release of pressure.

The calculated tension at the test pressure of 730 psi. is equal to the hoop stress times Poisson's ratio, or 13,000 psi. The release of this tension is equivalent to initiation of a compressive wave in the pipe wall which calculations indicate could result in a cumulative movement of 14 in. ½ mile from the break if there were no friction. Of course the actual deflection would be a great deal less if the supports offered appreciable resistance, and if they had not been crippled by web failure the line might have returned almost to its original position after the break occurred.

There were two other sudden failures, neither of which produced any comparable result, and this was the principal reason for concluding that the larger part of the axial motion was due to unequally distributed locked-up stresses. Unquestionably at least a part of it was, but there is no way of being absolutely sure that the other two failures were as sudden, even though their appearance was not dissimilar.

After these failures, precautions were taken to free up adjacent sections of the line before welding them together. Moreover, it was decided that full-strength anchors should be installed at intervals of about 2,000 m. in order to limit the results of any future accident of this type to a short distance. Of course these anchors increase the comparative cost of the aboveground construction, and since the selection among the various methods of laying pipe are based on costs as determined by field experience this will increase the proportion of the pipe that is buried, as well as partially buried.

The portion of the pipe line that is buried will be wrapped, and cathodic protection will be applied where it seems warranted. The wrapping so far applied consists of a primer, a heavy coat of asphalt, a wrap of glass fabric, a second coat of asphalt, and finally an exterior wrap of asbestos fabric. In addition, the bottom of the ditch is covered with a fabric padding to minimize the hazard of having the coating damaged before the backfill is complete.

Results Are Promising

The results so far obtained with this type of coating have been very promising. Most of it has so far been installed in the dikaka country where the sand is stable and has a high electrical resistance, but where damp, salty, low-resistance soil can be reached by excavating 10 to 20 ft. Under these favorable circumstances, a single magnesium anode dropped into the salty material has in several instances depressed the electrical potential of the pipe more than a volt for 10 or 15 miles.

It is fully realized, of course, that this extremely favorable situation will not exist in the more easterly parts of the line, and it is, in fact, expected that suitable low-resistance spots for anodes may be difficult to obtain, and that most of the protection may have to be supplied by magnesium ribbon and by anodes in deep wells at the station sites where plenty of power is available. Nevertheless, the high initial resistance of the wrapped coating so far applied furnishes a strong basis for the belief that, with a little care, corrosion of the buried sections of this pipe line can be virtually prevented.

The interior surface of this pipe is very smooth, at least when it leaves the mill, and it was believed that no allowance for roughness was necessary and that all calculations could be made on the basis of fully smooth pipe as determined by the Nikuradse or Lees equations. The latter was the one actually used for all the earlier calculations, merely because it happened to be more convenient at the time. The two equations agree almost exactly at any Reynolds number in the vicinity of 100,000. At this point the friction factors for clean steel pipe proposed by Colebrook and Rouse are only 1½ per cent above the factors

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for smooth pipe. Moreover, there appears to be quite a little evidence accumulating with the operation of large gas lines to show that for really clean steel pipe the Colebrook-Rouse figures are high. At 315,000 bbl. per day in 29.5-in. diameter pipe the Reynolds number is 82,000 at 12 centistokes viscosity.

The early calculations were made on a uniform viscosity of 12 centistokes. It was realized that this was somewhat high, and as more definite evidence accumulated the viscosities used in estimating were reduced and refined. The most recent calculations have assumed an average viscosity of 4.8 centistokes at the beginning of the line and 7.9 at the Mediterranean terminal. These are averages based on temperatures of 100° and 70° F. respectively. Temperatures in the winter will of course be lower and in the summer higher. Furthermore, there will be very material diurnal variations in those parts of the line laid aboveground. Various curve sheets were drawn up from time to time to facilitate the numerous calculations made on the basis of innumerable variations, but much of it was done on the slide rule.

The pumping stations on the Trans-Arabian pipe line are of interest mainly because of their large size rather than because of any particular unusual features or departures from ordinary practice. At the time of their design, a careful study was made to determine whether they should be driven by steam or by internal-combustion engines, since these two sources of power were the only ones commercially available at that time.

At first the use of steam appeared preposterous in a country where there is very little water, and where all of that is bad. Ordinary well water in eastern Arabia usually has about 3,500 p.p.m. of total solids, and of this 750 parts or more is hardness. In fact, the steam power plant at Ras Tanura refinery perhaps operates with water that is as bad as any now used by a steam plant anywhere.

Limited Water Supply

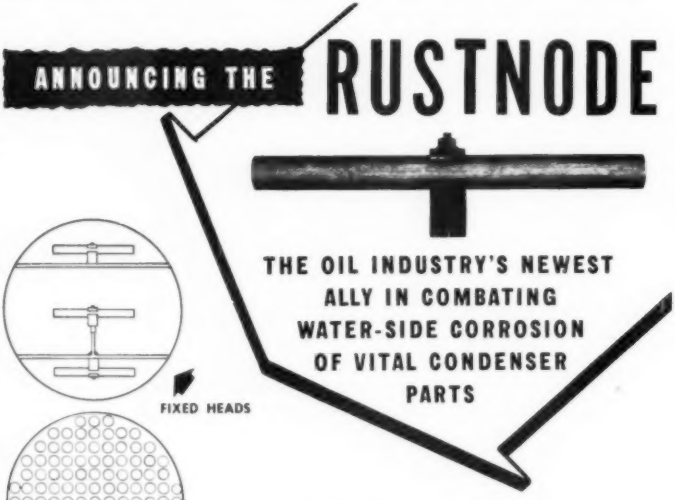
Although well water can be obtained at varying depths nearly everywhere along the right-of-way, the underground supply is unquestionably very limited, and the amount of water required for a cooling tower for a steam station would have been prohibitive. This led to the consideration of dry air-blown condensers utilizing finned tubes or other types of extended surfaces.

It was estimated that steam could be condensed at 5 psig. under the most adverse circumstances in such a dry condenser. Of course during the night and in the winter conditions would be more favorable, and it would be possible to operate a condenser under vacuum if such operation was desired. The size of condenser required turned out to be perfectly practicable. It was estimated that by operating boilers at a pressure of 900 psi. and 750° F., exhausting at 5 psi., a water rate in the vicinity of 11 lb. per horsepower-hour should be obtainable.

The steam plant would have the advantage of fewer operating units and much less inherent complication, but even with the water rate quoted the over-all fuel consumption would probably be 18,500 B.t.u. per hydraulic horsepower-hour as compared to 9,500 B.t.u. for a diesel plant. It was finally decided to go ahead with the more orthodox internal-combustion engines at all of the stations except at Station No. 1 in Abqaiq field where there is a virtually unlimited amount of surplus sour gas for fuel.

Station No. 1 contains two 6,000-hp. steam turbines directly coupled to two-stage centrifugal pumps, each capable of delivering about 340,000 bbl. per day against a maximum of 840-lb. pressure. The exhaust from these turbines will, under normal circumstances, be used for heating in a stabilizer which removes hydrogen sulfide from the crude oil, but it can be alternately routed to dry air-blown condensers of the type previously mentioned in case operation

ANNOUNCING THE RUSTNODE



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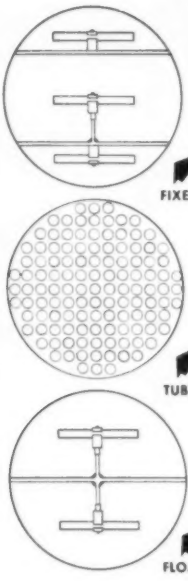

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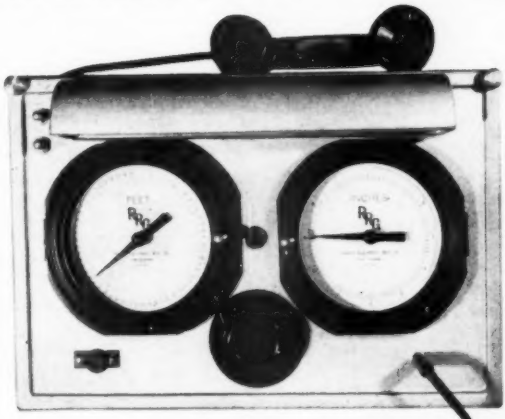

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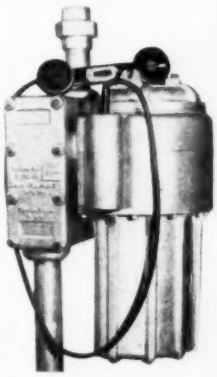

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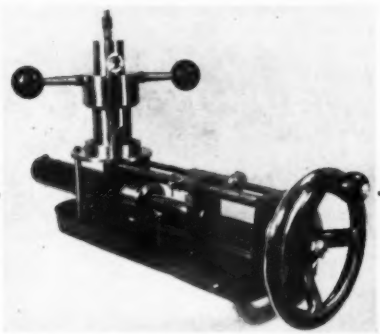

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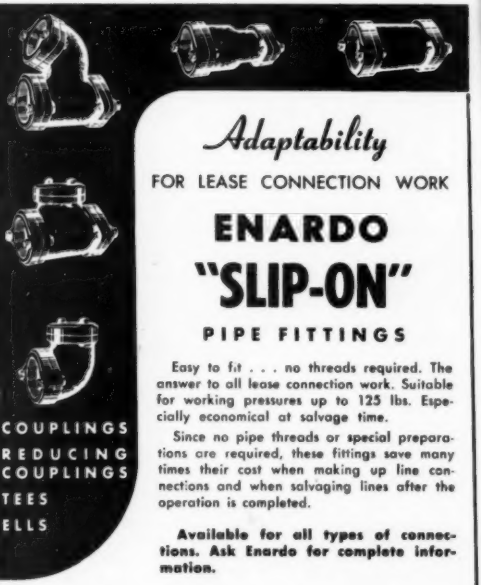

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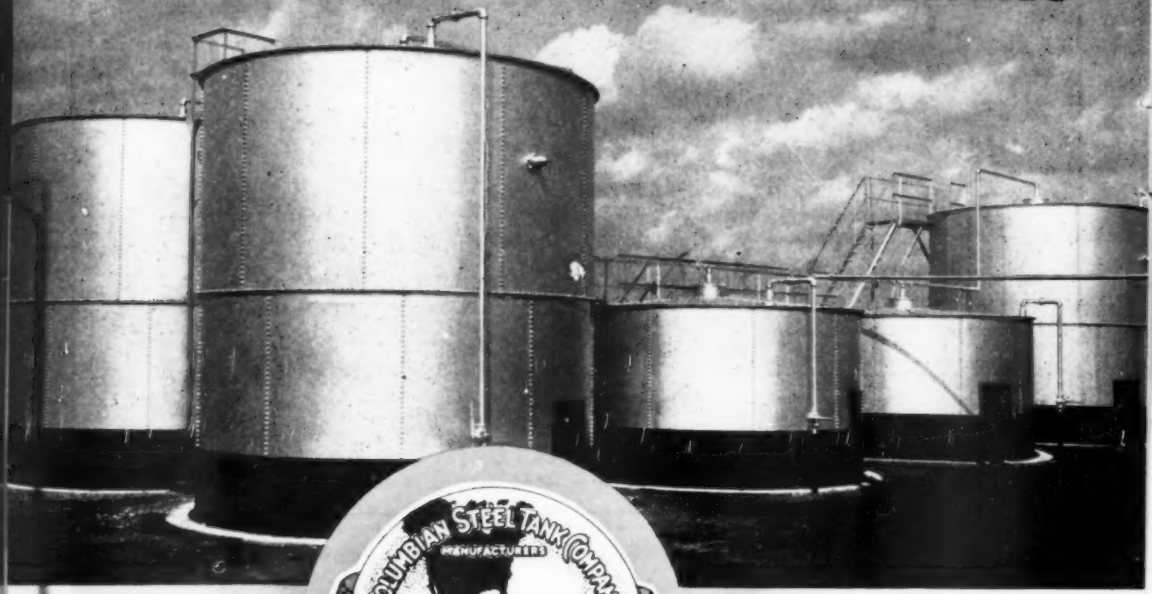

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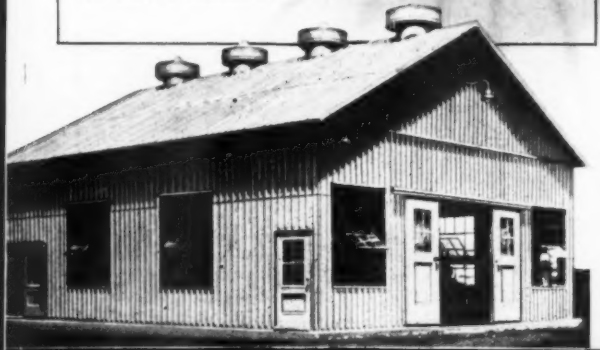

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of the stabilizer does not parallel pumping requirements.

As a matter of possible interest it may be mentioned that Arabian American Oil Co. is just completing a 20,000-kw. steam power station in the same location. This power station will exhaust to dry air-blown condensers at 5 psig., but steam will also be extracted at 50 lb. for additional heating in the crude-oil stabilizer.

High-speed pumps of the type used at Station No. 1 require adequate pressure on the suction. This is provided by two vertical pumps in the tank field, each capable of delivering full pipe-line capacity at about 75 psi. All the usual accessories for a modern pumping station will be used. Precision gaging of oil for royalty purposes in this area is accomplished by balancing the oil column against a mercury manometer which, when properly done, has been found more accurate than the conventional method of tape gaging used in this country.

Design of Station Pumps

The pumps at Station No. 1 are of conventional design, although they are perhaps the largest units of their type ever built. On account of the large shaft and the high peripheral velocities and comparatively high pressures, packing difficulties were feared, and it was finally decided to eliminate all packing and simply to install labyrinth bushings successively bled to lower pressures and, finally, to a sump whence the leakage is returned to the line.

As indicated, Stations 2 to 6 inclusive will be of the conventional type, operating with single-stage centrifugal pumps in series. The pumps are driven by 1,700-hp. diesel engines through speed-up gears. They operate at a nominal 2,200 r.p.m. and the engines at 343 r.p.m. The engines are of the four-cycle type, supercharged by the Elliott Buchi system. They have eight cylinders, 16-in. bore by 20-in. stroke, and are capable of operating at 120 psi. b.m.e.p. There will be five pumps in series, four normally operating to meet the requirements of the line and one spare. The individual pumps are bypassed with lines containing check valves and, of course, have motor-operated suction and discharge valves. Any unit can therefore be started and stopped without disturbing other units.

Besides the main driving units for the pumps, there will be three electric generators, one a spare, for driving auxiliaries, including the fans of the extended-surface dry air-blown radiators that will cool the packet water and the lubricating oil. They will supply power for all incidental uses, including air cooling of the living quarters and refrigeration. Other important auxiliaries include pumps for the water wells and an auxiliary booster pump for putting pressure on the main pump suction when it is necessary to draw oil from the station tank. These generators will be driven by six-cylinder engines having the same cylinder dimensions and other general characteristics as the engines used for pumping.

The stations are piped in such a manner that they can be operated either straight through with "closed suction" or by floating a 96,000-bbl. tank on the line coming into the station. In the latter case, the electrically driven booster pumps just mentioned are provided to raise the pressure on the suction of the main pumps enough to prevent cavitation.

In order to avoid overpressuring the pipe line in case of accident or faulty operation, especially when operating with closed suction, it is now contemplated that relief valves of special design will be installed on both the incoming and outgoing main lines. In addition, overpressure trips will be installed to shut down one or more of the engines in case of overpressure on the discharge of the station.

Conventional scraper traps are being installed. The Arabian oil is known to be somewhat waxy. The pipe lines so far operated between the field and the Persian Gulf ter-

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RESOURCES

Cash and Due from Banks	$105,219,281.94
U. S. Government Securities	70,433,247.82
State, Municipal and Other Securities	3,018,717.16
Stock in Federal Reserve Bank	750,000.00
Loans and Discounts	135,215,978.29
Bank Premises and Equipment	2,212,781.55
Real Estate for Bank Expansion	1,291,959.54
Customers Liability—Acceptances & Letters of Credit	1,298,624.13
TOTAL	$319,440,590.43

LIABILITIES

Capital	$12,000,000.00	
Surplus	13,000,000.00	25,000,000.00
Undivided Profits		2,560,916.05
Reserve for Dividend, Payable July 1, 1949		240,000.00
Reserve for Contingencies		1,732,960.80
Reserve for Taxes, etc.		1,417,292.47
Acceptances and Letters of Credit		1,298,624.13
Deposits:		
Individual	$203,510,781.22	
Banks	81,700,852.26	
U. S. Government	1,979,163.50	287,190,796.98
TOTAL		$319,440,590.43

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

minals have not experienced wax deposits, probably because the oil has never had the chance to cool off in the short distances involved, but wax has accumulated in the tanks. In the higher elevations of western Arabia and Trans-Jordan, the oil temperature may fall as low as 55° F. in the winter. It is understood that the temperature of oil received at the Haifa terminal of Iraq Petroleum Co. falls as low as 57° F. in the winter, although the annual average is a little over 70° F. Scrapers, and hence scraper traps, are also of value to remove air during the filling of the line, to separate the water used for testing from the oil following, as well as to assist in removing a certain amount of rubbish which always seems to get into pipe lines during construction.

Pump and engine houses at the stations are 230 ft. long and 70 ft. wide, the pump room being separated from the engine room by a gas-tight firewall. As previously indicated, there will be three 800-kw. generators together with a sizable air-conditioning plant, a refrigeration plant, and a laundry. At the present time the plans are for the construction of six dwelling houses in addition to the superintendent's house, and a four-room bunkhouse for single employes. There will be a children's playground, a tennis court, a baseball diamond, and a swimming pool besides a community center and an infirmary.

In addition to the housing for Americans there will be quarters for about 24 Arab families and 200 Arab bachelors. The number of these Arab quarters may serve to emphasize that the cost of construction and operating a pipe-line station in the middle of the desert is something wholly beyond and apart from any mere pumping cost in terms of kilowatt hours such as one might talk about here in the United States.

Communications along the pipe line received very careful consideration from the start, and both wire lines and various forms of radio were considered. The wire line had three drawbacks. The first, of course, was expense, and the second was exposure to various forms of damage, including either unintentional or intentional sabotage from curious or malicious bands of nomads, but the consideration that loomed most important of all was that it would not be available during construction when communication was just as urgently needed as for operation.

Radio Facilities

Very high-frequency radio of the line-of-sight variety was believed by some of the radio engineers consulted to be the only type that would guarantee performance under all weather conditions, but it required towers and a supply of power at intermediate locations where no power was available from a reliable source. If unattended, such intermediate relay stations would also be subject to malicious damage, or pilfering. Again it was impossible to obtain the necessary equipment in time to be used in the construction program, and possibly not in time for operation at the time when it was then hoped to complete the pipe line.

It therefore seemed that some form of ordinary short-wave transmission was necessary for the construction program, and that experience might indicate that it could be expanded into a permanent system that would give reasonable satisfaction. This hope was partly based on the rather remarkable performance of the low-power transmitters which Arabian American Oil Co. geologists used in automobiles transmitting at a frequency of about 4 megacycles. The hope for satisfactory performance of the short-wave radio has apparently been more than borne out by the experience to date.

The temporary equipment consists principally of 1,000-watt transmitters at Beirut and Ras el Misha'ab, 300-watt transmitters at the main intermediate construction camps (only one

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of which is in operation at the time this is written), 50-watt transmitters at temporary tent camps, and 15-watt transmitters in certain of the motor equipment.

The through communication from Ras el Misha'ab to Beirut, an airline distance of 850 miles, has been almost faultless. Various frequencies can be used between 3 and 18 megacycles, and two are normally set up, but the changeover is manual. Communication with the 50 and 300-watt line transmitters is also excellent, and at times even the 15-watt automobile transmitters have been able to communicate three-quarters of the way across Arabia. Of course the latter situation is unusual and not to be depended on, but the automobile transmitters have ordinarily been able to get in communication with the nearest construction camps without difficulty.

Two Separate Sections

It is contemplated that the permanent installation will consist of two more or less separate systems, one a through system from Sidon to Dhahran, and the other a dispatching system for the pipe line, taking in all the intermediate stations as well as the terminals. The through system will utilize transmitters of 1,000 watts output feeding to rhombic antennas designed to obtain single-hop transmission. Three rhombic antennas will be used for reception in conjunction with a diversity receiving arrangement which automatically selects the strongest signal and virtually eliminates fading. The dispatching system will utilize three frequencies simultaneously to provide dependable communication to any or all stations at distances varying from 125 to 1,000 miles. The frequencies will be in the vicinity of 5, 10, and 16 megacycles.

The Mediterranean terminus of the Trans-Arabian pipe line will be a few miles south of Sidon at a point where the Zahrani River empties into the Mediterranean. It is planned to install 16 tanks of 180,000-bbl. capacity, each at elevations 285 to 378 ft. above the water. The tanks will be about 5,200 to 7,200 ft. from the shore. Four submarine loading lines will extend some 2,700 ft. from the beach to a point where the water is 50 to 55 ft. deep, and in addition there will be separate ballast lines. The initial installation will probably be the simplest necessary for loading tankers by gravity with crude oil at a high rate, although the possibility of a refinery at this point at some later date has always been borne in mind. Incidental facilities required for a submarine loading terminal are a separator for handling oily ballast, a communication system from ship to shore and from shore to tankage for controlling flow of oil, and a small pier for the launches that are necessary for handling ships' mooring lines, transferring personnel, and moving minor supplies.

The design of the facilities at Sidon has not been entirely completed at the time this paper is written, but probably there will be four 30-in. lines from the tankage to the beach where there will be a manifold and then four 30-in. submarine lines.

The permanent radio transmitting station will be located at Sidon rather than at Beirut where the present station is, but the headquarters of the company will in all probability remain in Beirut, which is only about 30 miles to the north, and is the metropolitan and commercial center of Lebanon. The exact design of the radio communication system is still being studied, and there is a possibility that some changes from the plan outlined will be made.

Trans-Arabian American Oil Co. and staff have extended every possible assistance in the preparation of this paper, and they are to be commended for the candor with which they have supplied information concerning some of their engineering and construction difficulties, as well as their generally well-thought-out and successful program for design and construction.

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Determination of Water Dew Point

(Continued from page 243)

top tray, and is therefore essentially saturated with a mixture of glycol, amine, and water vapors in proportion to their respective partial pressures at the pressure and temperature conditions prevailing at this point; any change in temperature or pressure will disturb this equilibrium. If the temperature of the gas stream is lowered an infinitesimal amount under true equilibrium conditions, a small quantity of liquid of essentially the same composition as that which the gas last contacted will condense.

Thus, in the customary use of the dew point indicator a film of liquid will appear on the mirror at some temperature lower than the equilibrium temperature at the top of the contactor. The temperature at which this liquid becomes visible to the eye of the operator will depend to a great extent upon the rate of cooling and technical manipulation, particularly since such systems may be subject to super-cooling, but in no event can this liquid consist solely of water, since it will always contain the components of the liquid treating system —glycol, amine, and water, or glycol and water.

Since this condition prevails, it is quite obvious that the observed so-called "dew point" obtained is not an index of the water content of the gas stream and cannot be made to be such, since under properly controlled equilibrium conditions for making such measurements, liquid will condense continuously on the mirror of the apparatus as the temperature is lowered, and this condensate will have a continuously varying composition. The first material condensed will have very little water and will be mainly glycol and amine. This liquid does not readily form a fog but is likely to spread evenly over large areas of the mirror and be unnoticed during the first phases of the operation.

Fig. 2 shows the variation of the composition of the material which will constitute the liquid phase on the surface of a mirror which is being cooled in a stream of gas which has been passed through a glycol-water dehydration system utilizing a solution of 95 per cent diethylene glycol, 5 per cent water operating at a contact temperature of 90° F., and a pressure of 500 psia.

Fig. 3 shows the same data for a dehydrater solution containing 70 per cent diethylene glycol, 25 per cent monoethanolamine and 5 per cent water. These curves were arrived at by equilibrium condensation calculations in 5°-10° F. intervals. They indicate quite clearly that in such systems a gradual condensing of liquids of steadily changing composition occurs as the temperature is lowered. It is therefore apparent that no distinct water dew point, dew point of any pure liquid, or liquid mixture exists unless the original contact temperature is considered to be the dew point. Several references[1] have been made in the literature to the difficulties encountered in using these dew-point indicators and some special techniques have been proposed to make possible some sort of useful indication with them, but all such attempts are simply compromises in an attempt to get an indication without regard for the fact that such an indication is theoretically inaccurate.

New Method Developed

In the light of the above considerations, data have been obtained in this laboratory and in the field in an attempt to determine the absolute water content of hydrocarbon gas streams effluent from such dehydraters. The method finally adopted for this work was based on the method proposed by Russell, Reid, and Huntington[2], with slight corrections.

The equipment required for the method is shown schematically in Fig. 4.

It consists of a sample valve, S. V., on the gas line to be sampled, followed by a water or steam bath, W.B., for the purpose of heating the gas before dropping the pressure into the absorption system. Following this water bath are the two absorption trains.

The first absorption train, for the removal of total vaporized liquid, consists of the valve V_1, preferably a $^1/_8$-in. needle valve, the two glass absorption tubes A_1 and A_2, and the wet test meter WTM_1. The absorption tubes A_1 and A_2 are glass U tubes 100 mm. long and 15 mm. inside diameter with stopcocks at the inlet and outlet ends. The second absorption train, for the removal of amine, consists of the valve V_2, also a $^1/_8$-in. needle valve, the absorption tube A_3, and the wet test meter WTM_2. The absorption tube, A_3, is a large test tube closed with a two-hole neoprene stopper carrying the gas inlet and outlet tubes. The gas inlet consists of a small fritted glass gas dispersion tube of 20 mm. diameter such as manufactured by Corning Glass Works; extra-coarse plates (Type EC) are preferably used in order to prevent too high a pressure drop across the plate. An absorption bottle such as described by the California Natural Gasoline Association[3] can also be used advantageously. Any suitable gas meter calibrated to 0.001 cu. ft. or 0.01 l. can be used for the measurement of the effluent gas, although a wet test meter is recommended.

The necessary reagents are:

Anhydrous magnesium perchlorate (Anhydrone).

0.02 N sodium hydroxide.

0.02 N sulfuric acid

Methyl red indicator (0.1 per cent in water).

Determination of total vaporized liquid.—The two absorption tubes A_1 and A_2 are filled with anhydrous magnesium perchlorate and purged with gas for a period of 15 minutes. This is necessary to saturate the magnesium perchlorate with hydrocarbon and thus to prevent erroneous results caused by hydrocarbon absorption. The tubes are then weighed on an analytical balance to an accuracy of 0.1 mg. and subsequently placed on the line in the same order as when purged; A_1 is connected to V_1 and A_2 to WTM_1; the connections should be made with short lengths of neoprene tubing.

The flow is started by opening valves S.V. and V_1; S.V. should be opened several turns so that full line pressure is maintained through the water bath to valve V_1, which is used as a throttling valve for flow rate control. The flow should be regulated so that a maximum of 6 cu. ft. per hour is maintained. After passage of a maximum total of 18 cu. ft., the gas is shut off, the tubes disconnected and again weighed on the analytical balance. If the analysis is run properly, the increase of weight of the second absorption tube should not exceed 5 per cent of the increase in weight of the first tube.

Determination of amine.—Absorption tube A_3 is filled with 50 ml. of 0.02 N sulfuric acid, using either a calibrated pipette or burette, the gas inlet is connected to V_2 and the gas outlet to WTM_2. The flow is started by opening V_2 and the flow rate is adjusted to a maximum of 6 cu. ft. per hour. Care must be taken not to pass the gas at too high a flow rate in order to avoid liquid losses by entrainment. After passage of a maximum total of 18 cu. ft. of gas the flow is stopped and the sulfuric acid is transferred to a 250-ml. wide-mouth Erlenmeyer flask. The tube A_3 is rinsed several times with small amounts of distilled water which are also added to the flask. The amine is subsequently determined by titrating the excess sulfuric acid with 0.02 N sodium hydroxide using methyl red as the indicator.

Determination of diethylene glycol.—The diethylene glycol content of the gas is determined by calculation, using the equilibrium chart shown in Fig. 5.

Care should be taken that S.V. is opened sufficiently so that the system is under full line pressure up to V_1 and V_2.

The absorption tubes A_1 and A_2 should be watched for change in color and accumulation of liquid. As soon as a yellow coloration or the appearance of droplets of liquid on the walls is noticed, the tubes should be emptied and loaded with fresh Anhydrone. Also if A_2 shows a weight increase larger than 5 per cent of the weight increase of A_1, the latter tube should be reloaded.

This method is not designed for separate analyses of the individual vaporized liquids since only the monoethanolamine is determined directly. However, since the amount of glycol vapor present in the gas is of the

TABLE 1—COMPARISON BETWEEN WATER DEW POINTS FOUND BY B. OF M. DEW-POINT INDICATOR AND BY DETERMINATION OF ABSOLUTE WATER CONTENT OF GAS IN EQUILIBRIUM WITH DIETHYLENE GLYCOL-MONOETHANOLAMINE-WATER

Gas pressure psia.	Gas temperature °F.	Liquid composition, wt. per cent			Lb. of H_2O per MMSCF	Equivalent dew point,* °F.	Determined dew point, °F.
		DEG	MEA	H_2O			
300	100	97.9		2.1	14.9	30	46, 47
600	103	75.4	19.2	5.4	20.0	52	58
600	110	77.6	17.0	5.4	23.9	59	53, 55
1,000	85	97.2		2.8	4.8	24	26, 39
1,000	100	97.0		3.0	7.2	35	28, 34

*Calculated from "Water Content of Natural Gas." (Fig. 7)

1st NATIONAL

STATEMENT OF CONDITION

At the close of business June 30, 1949

ASSETS

Cash on Hand and Due from Banks	$123,905,865.80
United States Securities Owned	62,793,551.00
State, County and Municipal Bonds and Other Securities	9,985,776.86
Loans and Discounts	123,041,217.19
Banking House and Equipment	2,998,235.06
Customers Liability, Account Acceptances	2,794.84
Other Assets	37,621.55
	$322,765,062.30

LIABILITIES

Capital Stock	$ 7,500,000.00	
Surplus Fund	7,500,000.00	
Undivided Profits	5,769,430.69	$ 20,769,430.69
Reserved for Contingencies		1,666,321.15
Reserved for Taxes, Etc.		2,038,437.48
Acceptances Executed for Customers		2,794.84
DEPOSITS:		
Individual	$214,678,702.10	
Banks and Bankers	77,876,424.70	
U. S. Gov't.	5,732,948.34	$298,288,075.14
		$322,765,062.30

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More than meets the eye!

CONSOLIDATED Safety Relief Valves go far beyond the mere requirements of a device to relieve pressure. A lifetime of experience in the solution of pressure relieving problems is reflected by *extra safeguards* against the many hazards frequently not anticipated by the purchaser of protective equipment.

Rated capacity for example. Can its permanence be taken for granted regardless of field adjustments? CONSOLIDATED capacity is not dependent upon multiple and adjustable rings. Secondary orifice dimensions, which affect capacity, are fixed in the design and cannot be accidently altered during maintenance or for any other reason.

How about *leakage* due to distortion under discharge piping stresses? The exclusive CONSOLIDATED outside bevel seat and floating guide construction introduces "flexibility" of seat contact under all conditions of operation.

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order of magnitude of 5 per cent or less of the total vaporized liquid, the use of an equilibrium chart for its determination is justified.

The procedure described above is designed for the analysis of gas at 500 to 1,000 psig., which is the operating pressure range commonly encountered in glycol-amine treating plants. If the gas to be analyzed is at lower pressures, and therefore larger amounts of vaporized liquid are carried by the gas, the amount of gas used for an analysis should be decreased accordingly. However, the maximum figures of 6 cu. ft. per hour and 18 cu. ft. of total gas passed should not be surpassed at any set of conditions.

This method can also be used in dehydration plants employing diethylene glycol-water solutions. For such a system the analysis is simplified by omitting the second train for the absorption of the amine. The total vaporized liquid is determined by absorption on anhydrous magnesium perchlorate and the glycol vapor calculated from the equilibrium chart. The water content is found by subtraction of the glycol from the total vaporized liquid.

Calculations

The gas volume read on the meter is corrected to standard conditions.*

$$\text{Corrected volume SCF} = \text{observed volume CF} \times \frac{(460 + 60)}{(460 + t)} \times \frac{P}{30} \times \frac{P - P^*}{P}$$

t = observed temperature, °F.
P = observed pressure, inches of mercury
P* = vapor pressure of water at observed temperature, inches of mercury

1. Total vaporized liquid:

$$\text{Grams of total vaporized liquid/SCF} = \frac{(W_2 - W_1) + (W_4 - W_3)}{SCF}$$

W_1 = weight in grams of A_1 before test
W_2 = weight in grams of A_1 after test
W_3 = weight in grams of A_2 before test
W_4 = weight in grams of A_2 after test
SCF = corrected gas volume

If the result is desired in pounds of total vaporized liquid per MMSCF; pounds of total vaporized liquid/MMSCF = 2.2×10^3 grams of total vaporized liquid/SCF.

2. Monoethanolamine vapor:

$$\text{Grams of MEA vapor/SCF} = \frac{(V_1 \times N_1 - V_2 \times N_2)\ 0.0611}{SCF}$$

V_1 = ml of H_2SO_4
N_1 = normality of H_2SO_4
V_2 = ml of NaOH
N_2 = normality of NaOH
Pounds of MEA vapor/MMSCF = 2.2×10^3 grams of MEA/SCF.

3. Diethylene glycol vapor:

The diethylene glycol vapor in the gas is calculated from the equilibrium chart (Fig. 5). For any given temperature and pressure:

$$K = Y/X$$

the solution of which may be obtained from the chart.

K = equilibrium constant, read from the chart for the operating conditions
Y = mol fraction of diethylene glycol vapor in gas, the quantity which it is desired to evaluate
X = mol fraction of diethylene glycol in liquid, which may be obtained from the following equation:

$$X = \frac{\dfrac{\text{weight \% DEG}}{106.1}}{\dfrac{\text{weight \% DEG}}{106.1} + \dfrac{\text{weight \% MEA}}{61.1} + \dfrac{\text{weight \% } H_2O}{18.0}}$$

Then:

$$Y = K \times \frac{\dfrac{\text{weight \% DEG}}{106.1}}{\dfrac{\text{weight \% DEG}}{106.1} + \dfrac{\text{weight \% MEA}}{61.1} + \dfrac{\text{weight \% } H_2O}{18.0}}$$

$$\text{Grams of DEG vapor} = Y \times 106.1/0.8366 = Y \times 126.8$$

Pounds of DEG vapor/MMSCF = 2.2×10^3 grams of DEG/SCF

4. Water vapor:

Grams of H_2O vapor/SCF = W_T/SCF — (W_A/SCF + W_G/SCF).
W_T = weight of total vaporized liquid
W_A = weight of MEA vapor
W_G = weight of DEG vapor
Pounds of H_2O vapor/MMSCF = 2.2×10^3 grams of H_2O vapor/SCF.

Fig. 6 presents data collected in this laboratory employing diethylene glycol-water and diethylene glycol-monoethanolamine water solutions in contact with hydrocarbon gas at different pressures and temperatures, following, in general, the method described above. The figure compares the experimental data obtained with a chart constructed partly from the data of Russell, Reid and Huntington,[1] and partly from information published by Carbide & Carbon Chemicals Corp.[2]

Table 1 shows dew points as actually indicated with the Bureau of Mines dew-point indicator compared with the dew-point temperature corresponding to the experimentally found water content of the gas stream as calculated from the data of McKetta and Katz[3] (Fig. 7). The discrepancies between these two temperatures are quite obvious.

It can be seen from the foregoing discussion that the glycol and amine vapors are a definitely measurable proportion of the total vaporized liquid in the equilibrium gas stream. Since it is well known that the injection of any water-soluble material, such as an alcohol, has a considerable depressing effect on the formation temperature of hydrates, it is obvious that the presence of glycol and amine vapors in the gas stream would have a similar action. Since in many instances, and particularly those involving natural gas transmission systems, the objective of gas dehydration is to prevent hydrate formation and subsequent stoppage of pipe lines, any means which depresses the hydrate formation temperature is desirable. Furthermore, in such cases where the gas stream contains organic liquids, the water content of the stream is no criterion of the temperature at which hydrates are formed and therefore determination of so-called "dew points" and water content cannot be correlated directly with the hydrate forming temperature.

It is interesting to note that a major pipe-line operator, employing a liquid dehydration system, has operated continuously throughout the coldest winter conditions encountered for many years without a single freeze of a line. This in spite of the fact that the temperatures in the line were considerably below the calculated water dew point of the gas entering the line and therefore hydrate formation was to be expected.

Since the liquid which condenses from the gas has an increasing amount of water carried with it as it condenses (Fig. 3), the equivalent water dew point of the gas is always below

*Standard conditions: 60° F., 30.0 in. of mercury, dry.

the actual temperature of the gas as long as the condensate is allowed to stay in contact with the gas. If the gas mentioned previously in connection with Fig. 3 from the glycol-amine plant were cooled to 60° F., the dew point calculated from the original water content (original equivalent water dew point 38° F.) would be lowered to 36° F. If it is cooled to 50° F. the equivalent water dew point is lowered to 34° F. and if it is cooled to 40° F. the residual water is sufficient to yield an equivalent water dew point of only 28° F. Therefore it becomes a question of the hydrate forming temperature of the condensate only which at 40° F. has 67 per cent water, the remainder being glycol and amine.

It appears to the authors that the dehydration of gas by liquid absorbing agents should be evaluated rather by the actual water content of the gas thus treated than by the dew point depression which is commonly used at present. Although a slightly more complicated and time-consuming analytical procedure is probably not justified for routine control, it is felt that it is indispensable in cases where a performance guarantee of equipment is involved.

It should be remembered finally that, although we have referred occasionally to phenomena occurring after the gas leaves the plant, this discussion is concerned primarily with analytical tools and methods and not with the theoretical or actual composition of condensates in pipe lines or even the presence or absence of them. Changes of pressure must also be considered along with changes of the temperature since the vapor-carrying capacity of a given gas varies rapidly with varying pressure and therefore this discussion has been confined to treating and dehydration systems in which the pressure is assumed to be constant.

Conclusions

1. Theoretical and experimental considerations indicate that the determination of the water content of gases evolving from liquid dehydrating systems cannot be determined by the use of the conventional dew point determination equipment.

2. Experimental and calculated figures show that gases evolving from dehydrating plants using liquid dehydrating agents carry condensable vapors other than water which constitute a considerable portion of the total condensable liquid content of the gas stream.

3. An analytical method for the determination of the actual water content of gases effluent from liquid dehydration systems is presented.

4. In the light of the preceding conclusions, it may be presumed that the hydrate formation temperature of such gas streams would be considerably lower than that which would be indicated solely by the water content of the gas stream.

5. Rating of the efficiency of dehydration equipment has the sole purpose of allowing control of the water content of the effluent gas stream at a low enough value that the water content of the condensate will not allow hydrate formation at the temperatures expected in the pipe line. Therefore the authors believe that the rating of such equipment should be based upon the actual water content and not on the dew point of the gas.

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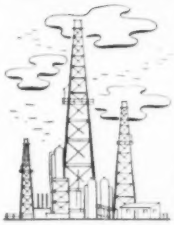

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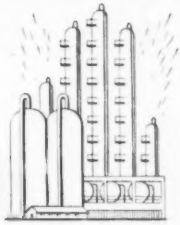

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Loosens seized and rusted nuts, bolts, pipe joints—any part frozen or stuck by chemical action or oxidation. Excellent cleaner for small metal parts. Supplied in handy, squirt-type pint cans.

Marine Corrosion Tests .. Show Practical Results

(Continued from page 237)

Roughly a half million pounds in magnesium sacrificial anodes have been produced by Dow in the past 1½ years.

Studies continue in order to determine magnesium alloys best suited to specific uses, and fundamental research in polarization is now under way. In addition to these long-term studies, other tests have at this time developed commercial applications.

Dow's experience with protection of piers and piling at the Freeport, Tex., plant shows an average annual cost of 2 cents per square foot for magnesium cathodic protection. It has further been determined that this type of protection decreases in cost with time. For example, at Freeport, adequate underwater protection originally required 3 ma. per square foot. The same degree of protection now requires but 1½ ma. This represents a proportionate reduction in consumption of magnesium anodes and the cost of continued protection.

For drilling platforms, piling, and piers, the combined studies at Kure Beach have resulted in the following recommended protection program. After installation, when and if permanent protection is desired, magnesium anodes are properly spaced on the submerged section and in the lower third of the tidal section (that vertical section between low and high tide). From that point up to mean high tide or higher, Monel sheathing is installed. Base of the sheathing is sealed with pitch, and the annular space between sheating and piling filled with heavy sweet oil. Seal is placed at the top and coat applied from that point upward. Sheathing should extend to a point at which coating may be applied and dried without interference from wave action at high tide. Sheathing may be fabricated in flanged half sections to fit the particular piling and bolted on, using gaskets.

Sea-Water Condensers

Corrosion tests of sea-water condensers and metals employed in pumps and other sea-water handling equipment, warrant the particular attention of the refining industry. Actually under test for the U. S. Navy are several oil coolers, employing high salt-water throughput rates. The use of zinc for cathodic protection of bronze, copper-nickel, and similar tube alloys is proved fairly successful when salt water circulates outside the tubes. When circulated inside tubes, however, such protection is not effective beyond one tube-diameter distance from each tube end. The position of zinc anodes inside the water box or recessed in the condenser shell is subject to further study. Tests with anodes of varying zinc content show that a zinc of 99.99 per cent purity gives three times the protection of a 99.90 per cent zinc anode.

Corrosion Program Extensive

The many projects simultaneously under way at Kure Beach are expected to result in important findings over a long future period. Many are general in nature and some projects involve fundamental studies. At this time, F. L. LaQue, in discussing results, touched on numerous scattered conclusions already reached in what is considered the early phase of corrosion study at the station.

For resistance to sea-water corrosion, cupro-nickel modified with iron has shown a well-established service. This alloy, comprising 90 per cent copper, 0.8-1.5 per cent iron, and 8.5-9.2 per cent nickel, appears to outperform aluminum brass in condenser tubes in low and high-velocity sea-water exposure tests.

In electroplated items of nickel and copper on iron with a thin chromium finish plate, samples have undergone thorough tests in sea-water atmospheres. The conclusion has been reached that extra copper thickness gives no appreciable advantage, but that the thickness of the over-lying nickel is the important factor.

Introducing the NEW
IMPROVED CHAMPION
SNATCH BLOCK
Featuring the SPEED NUT

Fig. 422

New "Speed Nut" eliminates all lower bolts, greatly facilitating opening and closing of block. No bolts to unscrew, pull out and lose. Two quick turns of "Speed Nut" and block is ready to open or close. Nut is never completely removed, and cannot be lost. Hook and clevis quickly interchangeable. For safe working loads up to 25 tons. Made from drop forged, heat treated, selected steel.

Write for Special Bulletin for complete details.

McKISSICK

McKISSICK PRODUCTS CORPORATION
Box 2496 Tulsa, Oklahoma

Design of Finned Tube Exchangers, Condensers

(Continued from page 258)

Heat balance for the temperature of the crude out gives:

$$\frac{0.610 \times 240 \times 1.750 \times 0.8762}{0.530 \times 5,000 \times 0.8498} + 160 = 260 \text{ F.}$$

Average wax distillate temperature = 330 F.

Average crude temperature = 200 F.

Tube side film coefficient = h_i = 250 B.t.u./hr.-F.-sq. ft.

Number of tubes per pass using the 4.2 g.p.m. per tube:

$$\text{From Fig. 3} = \frac{1,750 \times 42}{60 \times 24 \times 4.2} = 12.1 \text{ tubes}$$

per pass.

MTD = 138 F., uncorrected.

Corrected MTD = 114 F.

Estimated U_o = 30 B.t.u./hr.-F.-sq. ft. outside.

$$\text{Heat to be transferred} = \frac{1,750 \times 7.296 \times 42}{24} \times 0.610 \times 240 = 3,270,000 \text{ B.t.u./hr.}$$

$$\text{Heat transfer area} = \frac{3,270,000}{30 \times 114} = 960 \text{ sq. ft. outside.}$$

Length of tubing required = 960 × 0.604 = 1,550 ft.

Use 96 tubes approximately 16.5 ft. long.

Approximate shell diameter, $1^1/_8$-in. square pitch = 15 in.

Average mass velocity in shell:

G_{av} = 2 × 0.800 × 62.4 × 3,600 = 360,000 lb./hr. sq. ft.

For simplicity, let G_b = G_m + G_p = 504,000.

Baffle height = $12^1/_4$ in.

Baffle spacing = 6 in.

$$h_o = 1.28 \times \frac{0.076}{0.073} \times \left[\left(\frac{1.125 - 0.875}{1.125} \right) \frac{0.875}{12} \right]^{0.6} \times \left(\frac{0.310 \times 1.25 \times 2.42}{0.076} \right)^{1/3} \times \left(\frac{0.073 \times 360,000}{1.25 \times 2.42} \right)^{0.6} \quad (8)$$

h_o = 83 B.t.u./hr.-sq. ft.-F.

With a low outside coefficient, the fin efficiency, ϕ, will be substantially 1. The metal wall resistance may be neglected for copper.

$$U_o = \frac{1}{1.83 + 0.003 + (3.54 \times 0.002) + 3.54 \cdot 250} = 27.6 \text{ B.t.u./hr.-F.-sq. ft.}$$

Outside area necessary:

$$\frac{3,270,000}{27.6 \times 114} = 1,040 \text{ sq. ft.}$$

Total length of tubing required:

1,040 × 0.604 = 1,720 ft.

Length of tube bundle of 96 tubes:

17.95 ft. (Use 18-ft. tubes)

Final figures tube side, 96 tubes, 18 ft. long, 6 passes.

Shell 12-in. diameter, baffles $8^3/_4$ in. high, spaced 7 in.

The estimated pressure drop for the shell side is less than 5 psi. A similar calculation for a pressure drop of about 18 psi. on the shell side only required 75 per cent of the heat-transfer surface.

Air Cooler—Example 4

It is desired to cool 10,000 lb. per hour of air at 85 psig. from 220 to 100 F.

Water is available at 70 F. Assume fouling factors of 0.002 for both sides. Assume a water exit temperature of 100 F.

Heat to be removed from air = 10,000 × 120 × 0.238 = 285,000 B.t.u./hr.

Water rate = 285,000/30 = 9,500 lb./hr.

Assume 2 ft. per second water for the velocity. Use nominal $^5/_8$-in. diameter copper finned tube, $^3/_4$-in. plain end, 0.065-in. wall.

Water rate in gallons per minute per tube = 1.28 (Fig. 3).

$$\text{Tubes per pass} = \frac{9,500}{60 \times 1.28 \times 8.34} = 14.8$$

(Use 15).

$$\text{MTD uncorrected} = \frac{120 - 30}{\ln (120/30)} = 65 \text{ F.}$$

Estimated U_o = 20.

$$\text{Approximate area necessary} = \frac{285,000}{65 \times 20} = 220 \text{ sq. ft.}$$

220 × 0.508 = 435 ft. of tubing.

Length of bundle 4 pass water side = 60 tubes = 435/60 = 7.25 ft.

Diameter of shell for 1-in. triangular spacing = 12 in.

Water side coefficient

$$h_o = 0.023 \frac{0.356}{0.0412} \times \left(\frac{2 \times 62 \times 1,488 \times 0.0412}{0.810} \right)^{0.8} \times 192$$

h_o = 593 B.t.u./hr.-F.-sq. ft. inside.

Choose a mass velocity, G_m = 30,000 lb./sq. ft.-hr.

For simplicity G_b = G_p + G_m = 45,000.

Baffle height = $7^1/_4$ in.

Baffle spacing = 10 in.

$$h_o = 1.28 \times \frac{0.0168}{0.062} \left[\left(\frac{0.0834 - 0.062}{0.0834} \right) 0.062 \right]^{0.6} \times (0.74)^{1/3} \times \left(\frac{0.062 \times 30,000}{0.0196 \times 2.42} \right)^{0.6} \quad (8)$$

h_o = 34 B.t.u./hr.-F.-sq. ft. outside.

$$U_o = \frac{1}{1.34 \times 0.002 + (3.92 \times 0.002) + 3.92 \cdot 593} \quad (7)$$

U_o = 21.8 B.t.u./hr.-F.-sq. ft. outside.

Corrected MTD = 65 × 0.98 = 63.6 F.

$$\text{Area required} = \frac{285,000}{21.8 \times 63.6} = 206 \text{ sq. ft.}$$

$$\text{Total length of tubing required} = \frac{206}{0.508} = 405 \text{ ft.}$$

Length of tubes (60 tubes) = 405/60 = 6.75 ft.

These calculations assume the tubes would not be wet by water condensing from the air. Since the tubes near the exit of the air may be wet and have decreased coefficients, 8-ft. tubes would probably be used.

Nomenclature

- a_f = area of one side of one fin, sq. ft.
- A_{ef} = effective area of a finned tube, sq. ft./ft. (Eq. 9).
- A_f = area of fins, sq. ft./ft.
- A_i = area of inside of tube, sq. ft. ft.
- A_m = mean area of metal wall of tube, sq. ft./ft.
- A_r = area of plain tube having same diameter as root diameter of finned tube, sq. ft./ft.
- c = specific heat, B.t.u./lb.-F.
- D = diameter, ft.
- D_{eq} = equivalent diameter of finned tube by Eq. 3, ft.
- D_i = inside diameter, ft.
- D_o = outside diameter over fins, ft.
- D_r = root diameter, ft.
- g = acceleration due to gravity, 4.17 × 10^8 ft./hr.^{2}
- G_{av} = average mass velocity shell side of exchanger, lb./hr.-sq. ft. = $\frac{G_b + G_p + G_m}{3}$
- G_b = mass velocity through net opening at baffle, lb./hr.-sq. ft.
- G_m = mass velocity through maximum area perpendicular to tubes, lb./hr.-sq. ft.
- G_p = mass velocity through minimum area perpendicular to tubes, lb./hr.-sq. f.t
- h = film coefficient, B.t.u./hr.-F.-sq. ft. (h_i, inside tube; h_o, outside tube; h_{vf}, condensing vapor film coefficient; h_w, water film coefficient inside tube).
- DH = latent heat of vaporization, B.t.u. per lb.
- k = thermal conductivity, B.t.u./hr.-sq. ft.-F. per ft.
- L = height of vertical surface, ft.
- L_m = thickness of wall of tube, ft.
- MTD = mean temperature difference, °F.
- n = average number of tubes in a vertical row.
- p = tube spacing, ft.
- r = fouling factors (r_o, outside; r_i, inside).
- t = temperature.
- Δt_{vf} = temperature drop across condensing vapor film.
- X = total number of tubes in a condenser.
- ρ = density, lb./cu. ft.
- μ = viscosity, lb./hr.-ft.
- ϕ = fin efficiency.

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4. Katz, D. L., Beatty, K. D., and Foust, A. S., Trans. A.S.M.E., 67; 665-673 (1945).
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8. Short, B. E., University of Texas, Bulletin No. 4324, June 1943.
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QUESTIONS on TECHNOLOGY

by W. L. Nelson

Consulting Engineer

Oil Gas

Where should I turn in the oil industry to learn of the equipment used in the manufacture of oil gas? I am developing a metallurgical process which requires a gaseous fuel.—H.G.S.A.

Although enormous amounts of gas are produced as a byproduct at petroleum refineries in connection with cracking processes, not much oil gas is manufactured. The pure oil gas that is produced is made by processes similar to the Dayton process which involves the decomposition of the oil in an externally heated cast-iron retort. Air is also introduced into the retort and hence partial combustion also occurs in the retort. Very little of this type of gas is made.

The main use of oil in the manufacture of fuel gases is as an enrichment agent for water or blue gas. Water gas is made by blowing air through a bed of coal or coke. Combustion occurs and raises the temperature of the coke to a red heat. When heated steam is passed through the hot coke, decomposition of the steam into hydrogen and carbon monoxide occurs by combination with part of the coke. These gases have a heating value of only 228 B.t.u. per cu. ft. and hence "gas oil" is introduced into the water-gas generator during the "make." The gas oil is decomposed at the high temperature of the generator, and the high-heating-value oil gas raises the heating value of the whole gas product to 500-550 B.t.u. per cu. ft.

A modification of the carbureted water-gas process was at one time used extensively on the Pacific Coast because of the shortage of coal or coke in that region. In this process, heating oil is burned into a checker brickwork to raise the temperature. Steam and make oil is then introduced into the hot checkerwork producing water gas and oil gas, and some carbonaceous deposits and lampblack is also deposited on the hot brick. The carbonaceous material is burned off during the subsequent heating period but the lampblack is partly blown off and is troublesome. The process is more completely discussed in Fuels, Combustion and Furnaces, by Griswold (McGraw-Hill Book Co., Inc., 1946). The composition of the gas is somewhat as follows:

	Per cent
Hydrogen	45-55
Carbon monoxide	8-12
Methane	25-30
Illuminants	3- 5
Inerts	4.7-14

and it has a heating value of about 550. The best gas oils are those that are rich in paraffin and olefin hydrocarbons. *(W. L. Nelson, Oil and Gas Manufacture, The Oil and Gas Journal, February 26, 1948, p. 143).*

If the operation is small or of an experimental nature, the use of liquefied petroleum gases should be considered. These can be obtained cheaply if purchased in large quantities and by long contract.

Straightrun, Thermal, and Catalytic Distillates

Can a catalytically cracked fuel oil be distinguished by laboratory tests from a thermal or straightrun distillate?—F. E. F.

Although there are differences among the several kinds of distillates if some property such as boiling range is kept constant, it would be difficult to distinguish with certainty among them by means of routine laboratory tests.

Paraffin or mixed-base straightrun distillates could easily be discovered because of their high A.P.I. gravities, high pour points, high aniline points, or high U.O.P. characterization factors. However, naphthenic or coastal straightrun stocks have properties very much like those of regular thermal distillates, and distillates that have been flashed from cracked residuum are very similar to catalytic distillates. The situation is indicated in Table 1.

Means of Distinguishing

A means of distinguishing the naphthenic straightrun distillates from the two cracked ones, is the presence of unsaturated materials in the cracked distillates. Straightrun distillates (all crudes) contain no olefinic materials. However, this is not as simple as it sounds, because the ordinary methods of determining olefins such as solubility in sulfuric acid are not satisfactory. The sulfuric acid also dissolves aromatic hydrocarbons as well as paraffinic material. Thus a complicated chemical analysis must be undertaken.

All of the above suggestions are most general and it would require great skill to distinguish among the several types of distillates. However, much can be done with the gravities listed in Table 1. The paraffinic and mixed-base distillates of a given boiling range have high gravities. Naphthenic straightrun distillates are free from olefins whereas cracked distillates contain 3 to 20 per cent of olefins. The thermal flash distillates are not common (or at least are mixed with others) and hence most of the very low-gravity distillates are of catalytic origin.

Equilibrium Constants Of CO and HS

Can you publish or tell me where to find equilibrium data on carbon dioxide and hydrogen sulfide?—B. F. B.

At the moment this department does not have much in the way of data to suggest, but some comments are in order.

Both carbon dioxide and hydrogen sulfide exhibit a freak behavior with respect to vapor-liquid equilibrium, and since they would ordinarily be removed by means of chemical solutions, the ordinary concept of equilibrium constants as applied to hydrocarbon oils or mixtures is not entirely satisfactory. It is generally necessary to obtain data by laboratory work, for each system or material encountered. To our knowledge, no generalized equilibrium constants have been suggested or presented. The following references may be of some assistance:

1. Gilliland & Scheeline, High-Pressure Vapor-Liquid Equilibrium (Propylene-Isobutane and Propane-Hydrogen Sulfide), Ind. Eng. Chem., 32, 48 (1940).

2. Olds et al, Phase Equilibria in Hydrocarbon Systems (n-Butane-Carbon Dioxide), Ind. Eng. Chem., 41, 475 (1949).

3. Reamer et al, Phase Equilibria in Hydrocarbon Systems (Methane-Carbon Dioxide), Ind. Eng. Chem., 36, 88 (1944).

4. Poettmann & Katz, Phase Behavior of Binary Carbon Dioxide-Paraffin Systems, Ind. Eng. Chem., 37, 847 (1945).

5. Poettmann & Katz, Carbon Dioxide in a Natural Gas-Condensate System, Ind. Eng. Chem., 38, 530 (1946).

TABLE 1

Distillate—	Characterization factor	A.P.I. gravities for these mid-boiling points 450° F.	550° F.	650° F.
Paraffinic stock	12.2-12.5	47-52	41-46	37-42
Mixed-base stock	11.8-12.0	41-45	36-40	30-36
Naphthene-base stock†	11.0-11.8	29-42	24-36	19-33
Thermal distillate	11.2-11.8‡	32-42‡	27-36‡	22-33‡
Thermal flash dist.*	10.2-10.7	20-26	14-21	8-14
Catalytic distillate	10.3-10.6	21-25	14-20	10-16

*By flashing of residuum. †The low values are unusual because K is usually over 11.3. ‡High values are from paraffinic charge stocks.

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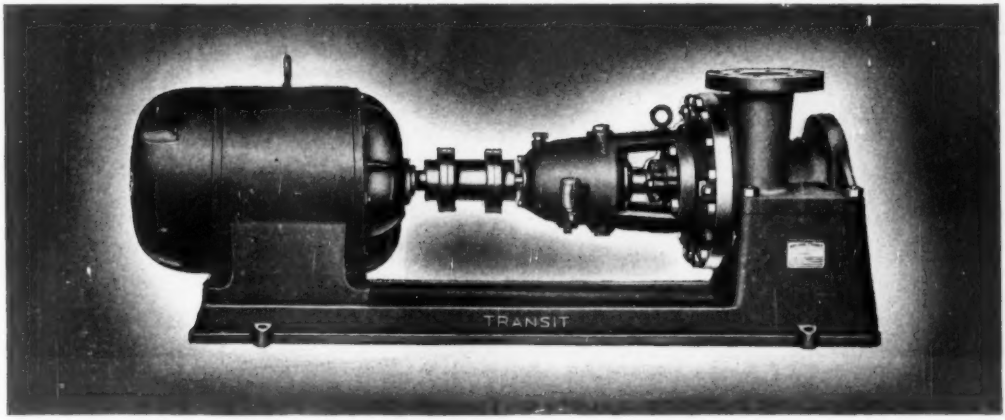

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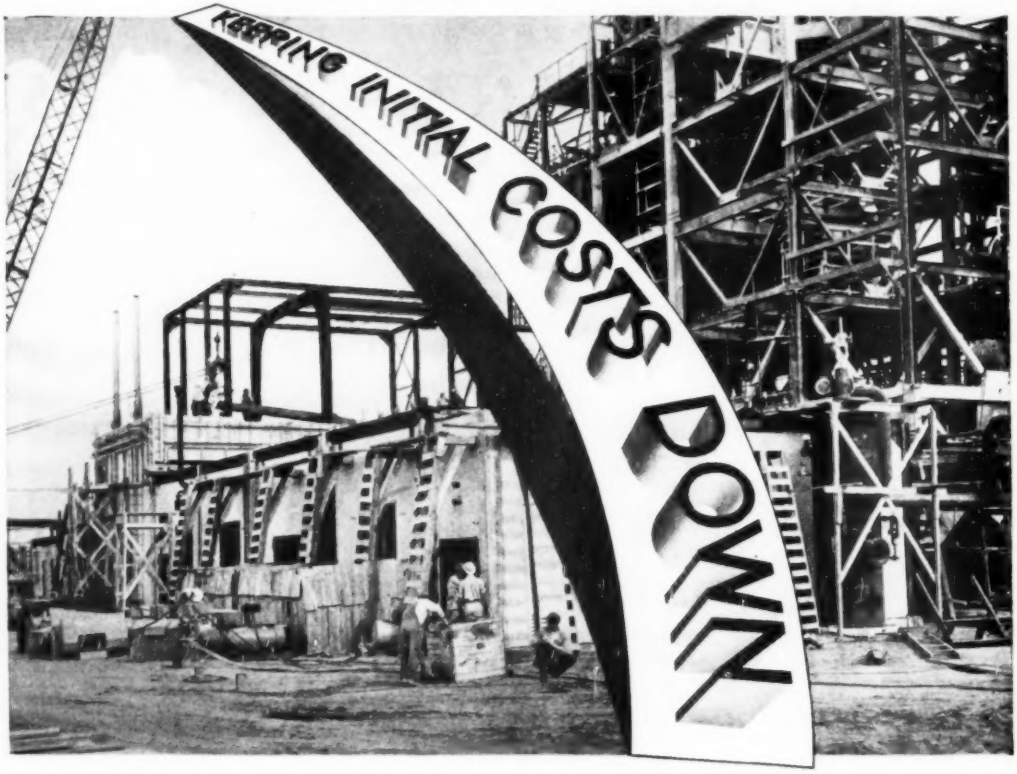

NOW—PRE-CAST WALLS THAT SAVE OVER 35%

Nearly everyone is familiar with the astronomical heights to which the costs of brick refinery buildings have risen. Some efforts have already been made to find lower costs methods. Among these is the use of concrete blocks, but this type of construction has the decided disadvantage of low structural strength to support equipment. Poured concrete walls remedy this defect but again prices soar because of tailor-made form work.

Seeking an economical solution to this problem, Kellogg's engineering and construction departments combined their efforts. They eventually arrived at a design that not only overcomes such disadvantages as low structural strength, but *saves upwards of 35% of the cost of brick buildings*. Moreover this new technique has a further advantage in that the buildings can be closed in a fraction of the time required for other types, thus permitting interior work to proceed regardless of weather.

Kellogg's concept isn't unusual, but the application is. Several recently completed large steel frame buildings and reinforced concrete super-structures were designed so that entire wall sections could be precast—*complete* with all door and window frames as well as conduit, duct and pipe inlets in place. Poured at the same time as the foundations, wall sections cure simultaneously and cranes can then lift them into position in a matter of minutes. The result: Modern, industrial housing with low maintenance and high functional value at radically lower costs.

This is another example of how completeness of staff and integration of operation benefit the refiner. Such attributes are the result of size, and of wide experience in both technical and managements phases. The M. W. Kellogg Company believes that such an organization is the only true approach to LOW INITIAL COSTS.

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Cost-imating

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

Structural Steel-Pipe Stills, Etc.

STRUCTURAL STEEL ESTIMATES

Item—	Cost-imating No. and Date
Breeching	No. 3, Nov. 4, 1948
	No. 26, April 14, 1949
Buckstays for condenser boxes	This issue
Condenser boxes	No. 3, Nov. 4, 1948
	This issue
Coil supports in condensers	This issue
Cranes	No. 18, Feb. 17, 1949
Frames	No. 28, April 28, 1949
Fencing	This issue
Grating	No. 18, Feb. 17, 1949
	No. 28, April 28, 1949
Handrails	No. 3, Nov. 4, 1948
	No. 18, Feb. 17, 1949
Ladders	No. 3, Nov. 4, 1948
	No. 13, Jan. 13, 1949
Percentage of total const. cost	No. 8, Dec. 9, 1948
Pipe supports	This issue
Pipe-still steel	No. 3, Nov. 4, 1948
	No. 26, April 14, 1949
	This issue
Plate	No. 3, Nov. 4, 1948
	No. 26, April 14, 1949
Platforms	No. 3, Nov. 4, 1948
	No. 13, Jan. 13, 1949
Pump-house steel	No. 3, Nov. 4, 1948
Stacks	No. 3, Nov. 4, 1948
	No. 26, April 14, 1949
Stairs	No. 18, Feb. 17, 1949
	No. 28, April 28, 1949
Structural steel, small members	No. 3, Nov. 4, 1948
Tower platforms	No. 13, Jan. 13, 1949
	No. 18, Feb. 17, 1949
Walkways	No. 18, Feb. 17, 1949
	No. 26, April 14, 1949
	No. 28, April 28, 1949

STRUCTURAL steel is not a large part of the total plant cost, only 0.5-3.0 per cent, including even walkways and platforms (Cost-imating No. 8, December 9, 1948, page 117), of the direct plant cost, and hence it can be estimated with sufficient accuracy without detailed drawings simply by visualizing the construction and resorting to tabulations of structural steel weights. However, several troublesome structures are estimated here.

The weights of pipe-still frames are indicated in Fig. 1, where the main types of construction are indicated by the position of the name. Heavy or complicated structures, or those employing suspended walls are the high limits of weight. None of the stills are sheathed with steel plate, and walkways, ladders, or stacks are not included.

The weights of the plate in water boxes for pipe coils easily can be estimated but they must be braced with vertical I-beams (buckstays). The weight of buckstay that should be used is indicated in Table 1.

The pipe coil must be supported at about 8-ft. intervals within the box. The weight of each support per pipe ranges from about 1.5 to 2.1 lb. Thus for a 30-ft. length, four supports are required and if there are 100 pipes, the total weight of coil supports is 600-800 lb.

TABLE 1—APPROXIMATE WEIGHT OF BUCKSTAYS (I-BEAM) FOR WATER BOXES

Height of box (ft.)	Center to center spacing of I-beams, ft. 5 ft.	6 ft.	7 ft.	8 ft.
4	3 in.- 5.7 lb.	3 in.- 5.7 lb.	3 in.- 5.7 lb.	3 in.- 5.7 lb.
6	4 in.- 7.7 lb.	4 in.- 7.7 lb.	5 in.-10.0 lb.	5 in.-10.0 lb.
8	6 in.-12.5 lb.	6 in.-12.5 lb.	7 in.-15.3 lb.	7 in.-15.3 lb.
10	8 in.-18.4 lb.	8 in.-18.4 lb.	9 in.-21.8 lb.	10 in.-25.4 lb.
12	10 in.-25.4 lb.	10 in.-25.4 lb.	12 in.-31.8 lb.	

Supports for carrying piping are sometimes constructed of structural steel. The approximate cost of installed steel and concrete supports for carrying three pipes at an elevation of 12 ft. is $10-$13 per support.

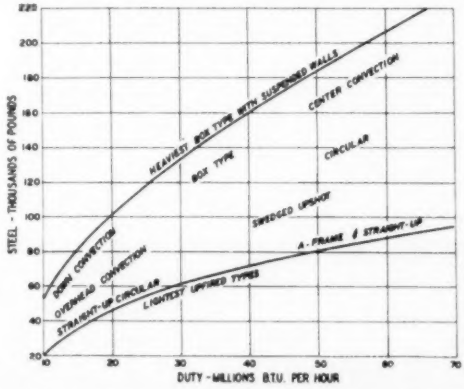
The cost of fencing is indicated in Table 2, and references to other discussions of structural steel are shown in the box on this page.

TABLE 2—APPROXIMATE COST OF FENCING (1946)*

Item—	Unit	M.	L.	Total
7-ft. fence complete	$ ft.	†1.03	0.65	1.68
Gates, 2-in. frame	$ ft. opening			5.5
Extra posts:				
Terminal	$ each			16.0
Corner	$ each			15.0

*Code 460, woven wire, wholesale prices, Department of Labor. †Six-foot woven and 1-ft. height of three barbed wire, posts, $1\frac{1}{2}$-in. top and brace rail, car load lots. ‡Two-cent per foot more for l.c.l. (less than car load).

Fig. 1—Approximate weight of pipe-still frames. Weights of each type are indicated by position of the names of the types



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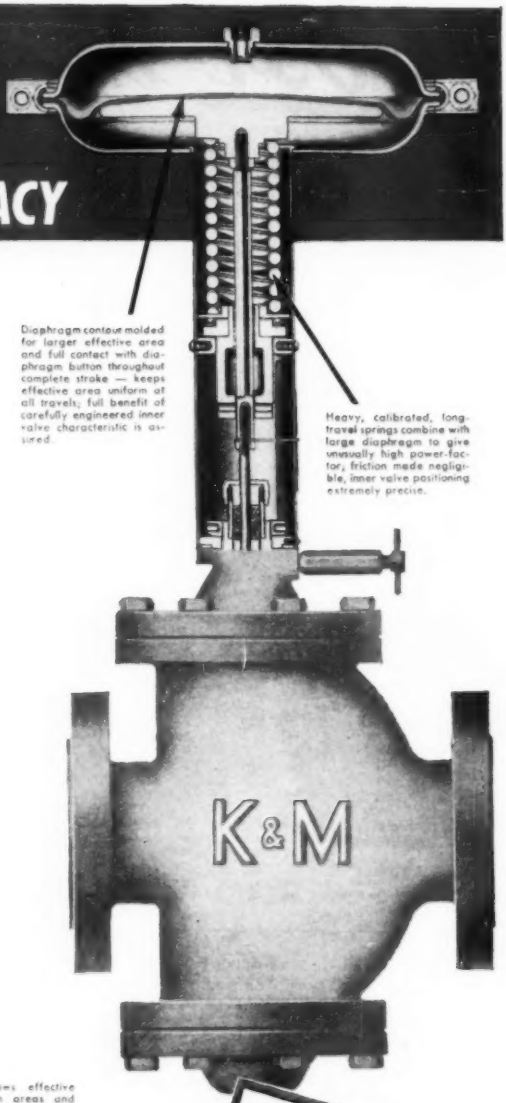
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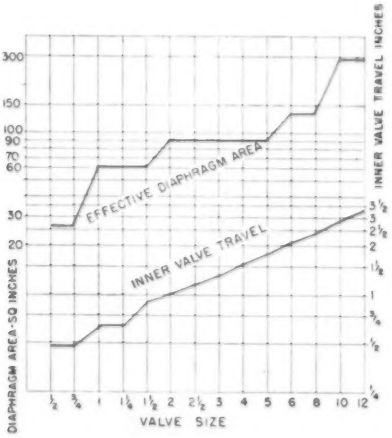

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ENGINEERING fundamentals

Phase Behavior—Retrograde Condensation

IN a previous installment of Engineering Fundamentals, it was noted that the dew-point line in a multicomponent system can double back in temperature so that the critical temperature is less than the maximum dew-point line temperature. Between these two temperatures, designated as points C and A on Fig. 1, the variation of phases with pressure reduction is an evidence of a phenomenon termed "retrograde condensation."

Consider the reduction in pressure between points P_1 T_1 and P_2 T_1 as shown in the figure. The phase changes for this path are shown in Fig. 2. At pressure P_1 the system is in a single phase designated as a vapor. Between points P_1 and P the vapor is expanded. At point P the first condensation of liquid appears, giving two phases. Between the points P and P′ two phases persist and the relative amount of liquid increases. At point P′ there will be more liquid present than at any other pressure on the path. In the particular case illustrated 12 per cent by volume is the maximum amount of liquid present. Between the points P′ and P″ the amount of liquid again decreases until at P″ the last vaporization occurs. From P″ to P_2 the vapor is expanded. Inasmuch as the pressure-reduction path begins and ends with a vapor phase, with intermediate liquefaction, the process is termed a retrograde condensation. Other retrograde paths can be liquid to liquid, or at constant pressure as well as at constant temperature.

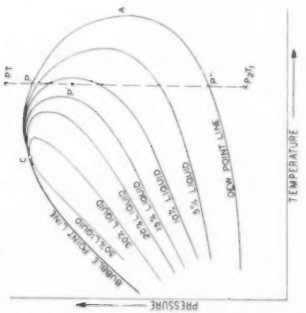

Fig. 1 — Hypothetical pressure temperature diagram of a multicomponent system

It is to be noted in Fig. 2 that although liquid increases in volume between the pressures P and P′ the specific volume of the system increases. This is contrary to the normally expected behavior of liquefaction upon decrease in specific volume.

Explanation of Retrograde Action

The explanation of the retrograde action can be given in terms of molecular attractions. In the system where there are A and B molecules there is an attraction between two A molecules, between two B molecules, and between an A and a B molecule. In considering pressure path from points P_2 to P_1, an increase in pressure, the behavior is at first what one considers "normal," i.e., liquid forms and increases in volume as pressure is applied. The liquid is at first richer in the high-boiling component A and the vapor is richer in the low-boiling component B. As the pressure is increased the vapor is compressed, the B molecules in the vapor move closer together thus increasing their total attraction for other molecules. The B molecules do not liquefy as they come closer together because the temperature is above the critical temperature for liquefaction of B molecules alone. The attraction in the vapor finally becomes strong enough to exceed the attraction between A molecules which enabled liquid to first form. The A molecules are revaporized, therefore, and as pressure is increased revaporization becomes complete.

The amount of liquid that will form during reduction in pressure over a retrograde path is dependent upon the temperature of the path. The closer the path is to the critical temperature the greater will be the amount of liquid formed.

Two-Component Systems

For two-component systems the region over which retrograde behavior occurs depends upon the spread of components, i.e., the effect is more pronounced in the system methane-heptane than in the system ethane-propane. For the same reasons the spread of temperature over which the retrograde phenomenon occurs for a multicomponent system (i.e., actual production) will be dependent upon the ratio of light to heavy components.

The liquid that exists as pressure is decreased on the retrograde path will not be constant in composition. This information cannot be shown on the type diagram shown in Fig. 1. The illustration of variation is simplest for the two-component system. Consider again molecules A and B, the former being higher boiling than the latter. The vapor will be richest in B molecules at pressure P′ (Fig. 2c). At pressures both above and below, the vapor will be less rich in B molecules. The liquid will be richest in A molecules at pressure P″ (Fig. 2d) and richest in B molecules at point P (Fig. 2b). The composition change for the liquid is gradual, there being no intermediate pressure where the composition variation changes direction.

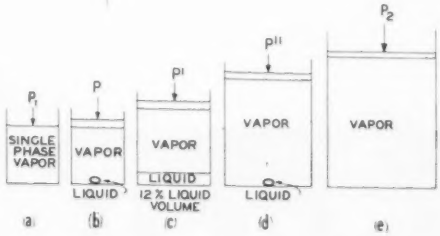

Fig. 2 — (Right) Diagrammatic representation of volume and phase changes upon reduction of pressure by retrograde condensation path

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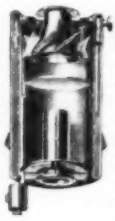

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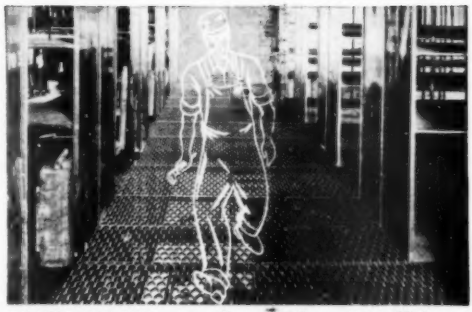

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REFINING

Union Oil Co. to Build New California Research Plant

Union Oil Co. of California has announced plans for construction of a new $5,000,000 research plant, to be located near Brea, Calif., 25 miles south of Los Angeles, which will replace its present research plant at Wilmington.

Reese H. Taylor, president, said that the new plant will include 12 buildings having a total of approximately 120,000 sq. ft. of floor space, and will occupy a tract of approximately 100 acres.

Final drafting of plans has been placed with architects, and construction will begin in September with occupancy scheduled for September 1950.

The 12 main units will include administrative offices, 3 unitized research laboratories, an analytical laboratory, engine laboratory, distillation and unit-process laboratory, a hazardous-operations laboratory, warehouse, combined power house and repair shop, library, snack bar, and recreation room.

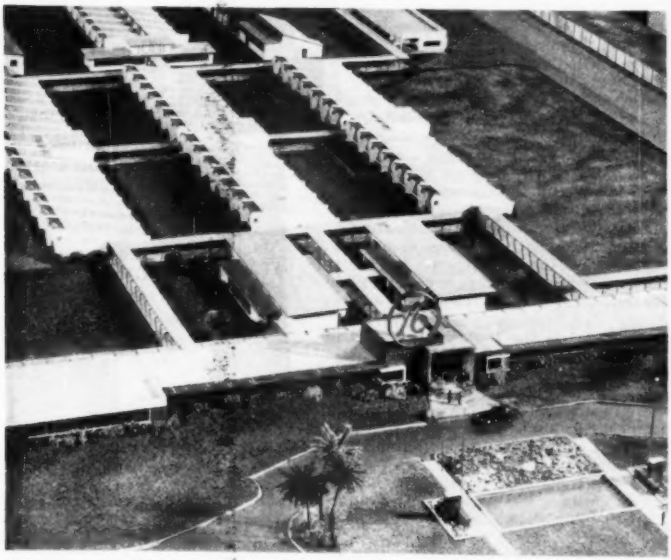
Taylor said that when the new plant is completed Union Oil Co. will have one of the most modern laboratories in existence. "It is planned to centralize all of the research activities of the company at the new site, including the broad fields of oil-field production research, petroleum products, and processing, and research in the field of petrochemicals," he said.

Ceremony to Open Carter's Billings Plant August 26

Formal opening of Carter Oil Co.'s new 20,000-bbl.-per-day refinery at Billings, Mont., will be held August 26, O. C. Schorp, president, announced. Gov. John W. Bonner of Montana will be the principal speaker at opening ceremonies.

Approximately 100 Montana business and governmental leaders will attend the opening, activities of which will include a tour of the new plant during the afternoon, followed by a banquet.

Recognized in industry circles as one of the most modern refineries in the world, the new Carter plant is an example of the latest type of manufacturing equipment and most advanced engineering design. It is capable of putting into operation re-



A scale model of the new $5,000,000 research plant which will be constructed at Brea, Calif., by Union Oil Co. The plant will incorporate 12 buildings having a total of 120,000 sq. ft. of floor space and will be used to centralize all research activities. It will replace the present research laboratory at Wilmington

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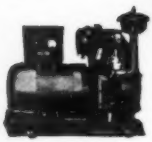

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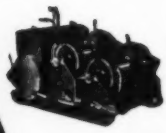

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cently developed practices in refining technology. *(A detailed article on the new plant appeared in the June 23, 1949, issue of The Oil and Gas Journal, page 112).*

Carter recently closed its old Billings refinery, which had a capacity of 9,000 bbl. daily. The old equipment was obsolete and the new manufacturing plant was necessary to "keep pace with product development in the industry," Shorp said. The new plant brings to Montana the fluid catalytic cracking process for the first time.

Contract Let For Work At Humble's Baytown Plant

HOUSTON.—Humble Oil & Refining Co. has awarded W. S. Bellows Construction Corp. contract for four projects at its Baytown, Tex., refinery totaling approximately $1,000,000.

Included in the project will be a warehouse and shop building to contain 56,000 sq. ft. of floor space, a one-story building and mezzanine equipment building to have 2,500 sq. ft. of floor space, and an outside-storage yard to have 120,000 sq. ft. of paved area and railroad tracks.

Socony-Vacuum Completing Paulsboro Plant Expansion

A record construction program at the Paulsboro, N. J., refinery of Socony-Vacuum Oil Co., Inc., will be largely completed by November. Principally concerned with the expansion of lubricants manufacture, the program also increases crude capacity at the plant about 75 per cent and improves office and service facilities for employes.

The first unit to go on stream was a 4,450-bbl. per day furfural refining unit which began initial production in mid-May. Within 30 days, a combination atmospheric-vacuum crude unit will be in initial operation. Rated with a capacity for charging 19,500 bbl. per stream day, the new unit together with modifications in other crude-processing equipment in the plant will raise the refinery's charge capacity from 36,400 to 64,000 bbl. daily.

October 1 is the tentative date set for completion of the M.E.K. dewaxing unit which will handle up to 2,050 bbl. of charge per stream day. The last process unit in the current program, a 5,950-bbl. propane-deasphalting plant will go on production about November 1. A 3,000-bbl. contact-filtration plant formerly planned will not be built for the present.

To handle the increased volume of lubricating stocks from the process department, a revamping and expansion program is under way which will completely modernize the compounding and packaging department at the refinery.

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PIPE LINES

East Tennessee Builds 172-Mile, 22-In. Line

East Tennessee Natural Gas Co. is now constructing a 172-mile, 22-in. line from Greenbrier, Tenn., to Oak Ridge. Construction is being done by a joint venture operating as Oman-Fulton & Brodie, according to information received from R. H. Fulton at the Oman Construction Co. office at Gallatin, Tenn. Oman Construction Co. is successor to John Oman, Jr., Contractor, Nashville.

One spread is now working out of Gallatin; a second spread will be started early in August. The entire construction work is under the supervision of J. T. Brodie, general superintendent.

Northern Pipeline, Ltd., Formed for Canada System

A syndicate known as Northern Pipeline, Ltd., has been formed for the construction of a proposed $10,000,000 Montreal-Ottawa-Toronto 400-mile, 10-in. products pipe line. Construction is scheduled to start this fall for completion within a 9-month period.

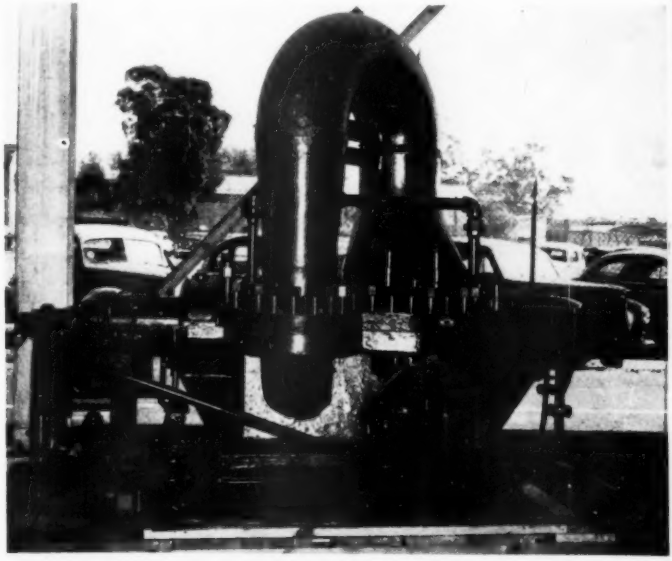
Northern Pipeline, Ltd., syndicate is reported as having been organized by three companies: Imperial Oil, Ltd., British American Oil Co., Ltd., and McColl-Frontenac Oil Co., Ltd. The Northern Pipeline setup appears to supplant Queont Pipe Line Co. with its project for a 330-mile Montreal-Toronto products line, with which the same interests were concerned according to an announcement earlier this year.

The proposed Northern Pipeline project according to reports, will have sufficient capacity for supplying the gasoline requirements of Ottawa and Toronto.

Virginia Natural Plans 153-Mile Gas Line

Virginia Natural Gas Co., of Richmond, is seeking Federal Power Commission authorization for construction of a $5,377,972 natural-gas pipe-line project to serve southeastern Virginia.

The company, recently formed for the purpose of constructing the facilities, proposes to build a 153-mile line in Virginia extending from a point near Buckingham on the Texas-to-New York pipe line now being built by Trans-Continental Gas Pipe Line Corp. The project also would



Main-line centrifugal pump specially designed by Byron Jackson Co. to serve the Trans-Arabian Pipe Line Co. project described in an article appearing on page 310 of this issue

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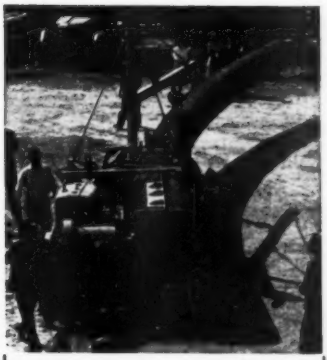
include about 12.5 miles of lateral lines.

Plan calls for the company to supply the entire natural-gas requirements of the city of Richmond, Petersburg & Hopewell Gas Co., Suffolk Gas Co., Portsmouth Gas Co., and Norfolk division of Virginia Electric & Power Co., all of which now distribute and sell manufactured gas.

Virginia Natural proposes to obtain its entire natural-gas requirements from the Trans-Continental line. The Virginia company's application said Trans-Continental would be able to commence deliveries not later than September 1, 1950.



Two joints of 30" pipe welded together to form a length 62' long, shown in the final Bending Stage in the "Cinch" Bender. Note how the pipe was bent continuously through the Welded Joint. This demonstration established firmly, quality on an Economical Basis.

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Oates to Direct Newly Formed Pipe-Line Firm

JAMES FRANKLIN OATES, JR., chairman of Peoples Gas Light & Coke Co. of Chicago and affiliated companies, including Natural Gas Pipeline Co. of America, since January 1948, will direct operations of the newly organized Texas Illinois Natural Gas Pipeline Co. The new company plans to construct and operate a 1,000-mile, 30-in. natural-gas line at an estimated cost of $100,000,000 from Houston to Joliet, Ill. *(The Oil and Gas Journal, July 21, 1949, page 111).*

While Oates is comparatively new to the natural-gas industry he is well known in Chicago as an attorney, which profession he followed before taking over the operation of Peoples Gas. A past president of Chicago Bar Association, Oates is a former chairman of the utilities section of the American Bar Association.

He served as a second lieutenant in World War I and in 1921 graduated from Princeton University with an A.B. degree. Immediately after graduating from Northwestern Law Schoo

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2—To act as pipe skids, facilitating installation.
3—To separate pipe and casing, assuring permanent insulation for cathodic protection.

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Equipped with exclusive T-gasket for positive water-tight seal and insulation of pipe from steel flanges, this improved "casing seal" is designed for easy installation at each end of pipe-line casing under right-of-way crossings.

WmSEAL Casing bushings are readily installed because they offer:

- Large center hole for loose fit around coated pipe.
- Generous clearance inside of casing before bolts are tightened.
- Easily opened after removal of only one bolt, for closing around installed pipe line. WmSEAL Casing Bushings are widely used as wall sleeves for valve boxes, manifolds, etc.

*Patents Pending

THE PIG WITH THE POKE CLEANS PIPE LINES

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n 1924 with a J.D. degree, Oates entered law firm of Cutting, Moore & Sidley, predecessor of the firm of Sidley, Austin, Burgess & Harper, of which he was a member from 1931 until 1947. He specialized in utility and public-service company matters.

During World War II he served as legal adviser to the Chicago Ordnance District, and later as chief of purchase policy for the Ordnance Department in Washington. For these services he received two citations, including the Meritorious Civilian Service Award.

Midstates Oil Corp. Buys Haynesville, La., Outlet

Middle States Petroleum Corp. has announced that its operating subsidiary, Midstates Oil Corp., has purchased from Southwest Natural Gas Co. a 13-mile, 8-in. gas pipe line from Haynesville, La., to the vicinity of Homer, La., where it connects with the 20-in. trunk line of United Gas Corp.

The purchased pipe line provides an outlet for gas production from Midstates' Smackover lime wells in Haynesville pool, which have largely been shut in because of lack of a satisfactory market outlet. Delivery of gas to United's line in substantial volume has already started and it is expected that the accompanying distillate produced with the gas will increase Midstates' production by approximately 1,000 bbl. daily.

Stanolind Quits Pumping at Two 16-In. Stations

Stanolind Pipe Line Co. has temporarily suspended operation of the Childress, Tex., and El Reno, Okla., pump stations of the 16-in. looped line from West Texas to Drumright, Okla.

This is a result of curtailment of runs by the Railroad Commission of Texas which leads to reduction of Stanolind's throughput, according to reports, from the 130,000-140,000 bbl. daily range to an estimated throughput of approximately 98,000 to 100,000 bbl. daily.

Texas Eastern to Sell Surplus Gas

Texas Eastern Transmission Corp. has been authorized by Federal Power Commission to deliver and sell, on an interruptible basis, surplus natural gas presently available on its pipeline system to gas-utility companies which are authorized firm purchasers.

Texas Eastern said the surplus, which will range from 60,290,000 cu. ft. per day in July to 24,250,000 cu. ft. daily in October, resulted from

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a lessened demand among some of its customer companies and because other authorized purchasers have not yet constructed facilities to connect with the Texas Eastern system.

The commission denied Texas Eastern's proposal to sell to utility companies or other concerns not authorized as customers of the pipe-line system any quantities of gas remaining after the demands of its authorized customers were met.

Texas Eastern, operating the so-called Big and Little Inch pipe-line system, sells natural gas on a firm basis to 13 companies and is authorized to sell to an additional 14.

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PIPE LINE SURVEYS

El Paso Plans $690,630 Project

El Paso Natural Gas Co. has asked the Federal Power Commission to authorize construction of pipe-line facilities to carry natural gas to the U. S. Army's White Sands Proving Ground, the Holloman Air Force Base, and the town of Alamogordo, all in New Mexico, and to Willcox, Ariz. The proposed project also would increase deliveries of natural gas to Phoenix by about 9,000,000 cu. ft. per day.

The plan calls for construction of a total of 93.1 miles of pipe line, to be built at an estimated cost of $690,630. The company said that the proposed facilities would have an initial daily capacity of 1,500,000 cu. ft. to the White Sands Proving Ground, 1,850,000 cu. ft. each to Holloman Air Force Base and Alamogordo, and 84,000 cu. ft. to Willcox.

According to El Paso's application, the Sacramento Corp. will supply gas to the White Sands Proving Ground, the Holloman Air Force Base, and the city of Alamogordo. Distribution in Willcox will be made by that city, and in Phoenix by Central Arizona Light & Power Co. El Paso said the White Sands Proving Ground and Holloman Air Force Base now use oil for fuel, and that Willcox and Alamogordo use manufactured gas.

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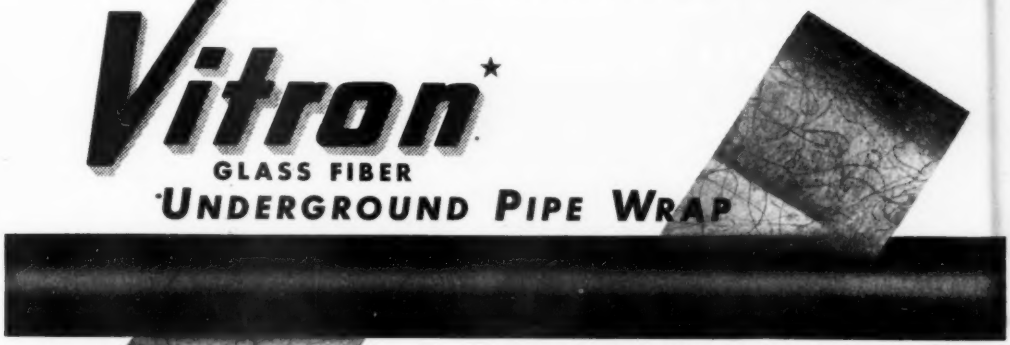

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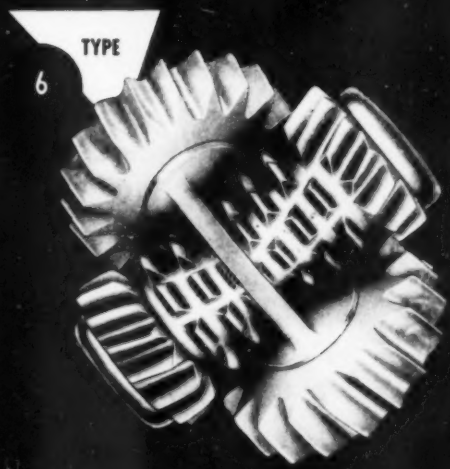

Among the

Drilling Contractors

Number of Rigs Operating Holds Steady During Week

Possibility that the downward trend in drilling activity which has been apparent for several months may be coming to an end is indicated by the leveling off in the number of rotary rigs reported in operation during the week ended July 18. During this week, the latest for which figures are available, the number of rotary rigs operating in the United States and Western Canada was only 1 below the number operating during the previous week. This was in contrast to a decline of 39 reported for the week ended July 11 as compared with its preceding week.

ROTARY RIGS IN OPERATION*
(United States and Western Canada)

Area	Week ended 7-18-49	Change week ended 7-11-49	Change week ended 7-19-48
Gulf Coast	523	—7	—78
W. Tex.-N. M.	511	—3	—89
Ark.-N. La.-E. Tex.	159	+2	—6
Oklahoma	222	—6	—79
Kansas	122	+6	—0
Illinois-Eastern	128	—1	—5
Rocky Mountains	112	+4	—56
Pacific Coast	178	+1	—12
Total U. S.	1,955	—1	—325
Western Canada	69	+3	+20
Total	2,024	—1	—305

*Courtesy Hughes Tool Co.

E. K. Carey Drilling Co., Denver, as contractor and joint operator with Derby Oil Co. and W. C. McBride, Inc., has projected a wildcat test to be drilled on the Axial basin anticline in Moffat County, northwestern Colorado. Objective is the Weber sand, the productive horizon of the prolific Rangely field.

Ace Drilling Co., Wichita Falls, Tex., is moving in tools for a wildcat test to be drilled for Mid-Continent Petroleum Co. in the C. H. Simpson survey, 8 miles northeast of Jacksboro, Jack County, North Central Texas. Contract is for 7,000 ft.

Commonwealth Drilling Co., Calgary, is moving in to drill a wildcat test for the Barnsdall-Honolulu-Seaboard group in the Lyle Lake area, 125 miles northeast of Edmonton in northern Alberta Province, Canada.

Permian Basin Drilling Co., Odessa, Tex., is starting a 4,000-ft. wildcat test for F. B. Seale and associates about 8 miles south of Akele, N. M., and about 35 miles west of Las Cruces. Rotary tools are being used.

Sterling Drilling Co., Calgary, is moving in to drill a wildcat test for the Oyen-Wheat King combination in LSD 1, 3-27-5w4, about 8 miles southwest of Oyen and about 150 miles east of Calgary in Alberta Province, Canada.

Ozra Bather, Comanche, Okla., is starting a 2,000-ft. wildcat test for Sellars & Inge, Monroe, La., in the NE cor. 11-6n-14w, eastern Kiowa County, Oklahoma.

Caroco Drilling Co., Dallas, is starting a second well for E. Constantin, Jr., in the rapidly developing Elk City field in Beckham and Washita

Drilling crew for Arrow Drilling Co., Tulsa, on Fred M. Manning, Inc., 2 McNeer, East Lindsay pool, Garvin County, Oklahoma. Left to right: Leonard Hudson, toolpusher; W. W. Moore, driller; E. T. Harper, derrickman; S. E. Hudson, C. N. Pendergraft, and Ray Satterwhite, floormen

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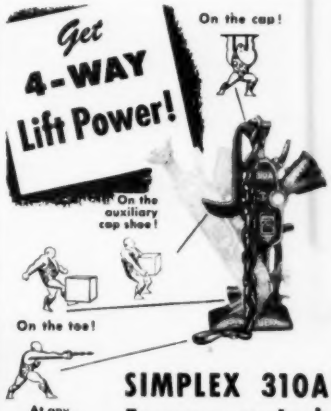

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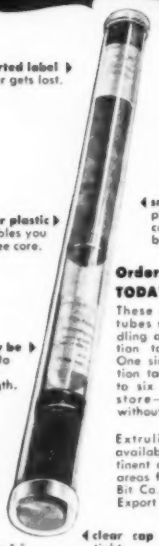
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light, unbreakable plastic. Perfect for air freight.
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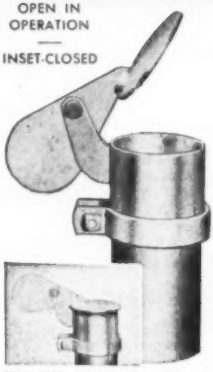

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The "Weathercap" exhaust pipe cover is counterbalanced to open instantly from the engine exhaust pressure—closes automatically when engine shuts down.

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counties, Oklahoma. The new test is a 40-acre location east of the same operator's first well, just completed, which extends production 1½ miles east into Washita County.

Mercury Drilling Co., Tulsa, is starting a well with Bay Petroleum in the Bethany pool, Oklahoma County, Okla. It will be their 1 Cook Unit, SE SE NW 22-12n-4w. It is projected to 7,300 ft. to take in the Hunton lime. Mercury tools have just completed a good Hunton lime well in the Coffee Creek pool, same county, in another joint operation with Bay Petroleum Co.

R. C. Patton, Wichita, is the contractor on a wildcat test which Barlara Oil Co. has started northeast of Gerlane, Barber County, Kansas. The test is in 15-33-11.

Mose R. Wagner, a northern Montana drilling contractor, has announced location for an extension test to the Melstone field, Musselshell County, Montana, which he will drill for himself. The well will be 1 Jacques, C NW SE 6-9n-30e.

Advance Drilling Co., Evansville, Ind., is starting a 3,200-ft. Devonian test for Gyro Oil Co., Inc., and itself in the Hazelton area, Knox County, Indiana. Location is in Mil Don 205-1n-10w.

Marhenke Drilling Co., Augusta, Kans., is starting a wildcat test for J. P. Gaty in 30-26-2e, northeast of the Hinkle pool, Sedgwick County, Kansas.

Harlan Park Drilling Co., Owensboro, Ky., has been given contracts for two wells which Simon Lebow will drill in 9-1s-9w, Pike County, Indiana. Contracts are for 1,750 ft., which will take in the McClosky lime. The same contractor will drill a shallow McClosky test for Snyder and associates in 26-5n-7w, Daviess County.

Tilley Drilling Co., Wewoka, Okla., is drilling a wildcat test for itself and Otto M. Vaughn north of Wanette, Pottawatomie County, Oklahoma. Location is in 19-6n-3e. Projected depth is 3,250 ft.

Big Chief Drilling Co., Oklahoma City, drilling for itself and W. B. Osborn, is opening a new pool in Lincoln County, Mississippi. The discovery well, 1 Ziegler, NW NW 2-6n-7e, is located between the Brookhaven and Mallalieu fields, and is good for about 195 bbl. of net oil per day from Tuscaloosa sand at 10,563-70 ft.

Ray Johnston, owner of **Johnston Drilling Co.,** Evansville, Ind., has organized a new company to be known as Johnston Petroleum Co. to operate oil properties he holds in the Illinois basin area.

Crowe Drilling Co., Wichita, is the contractor and a partner with J. M. Huber Corp. in the opening of a new pool, 2 miles east of the Bemis-Shutts field, Ellis County, Kansas. The discovery well, 1 Chrisler, 22-11-16, made 54 bbl. net oil on potential test from Lansing sand at 3,100-12 ft.

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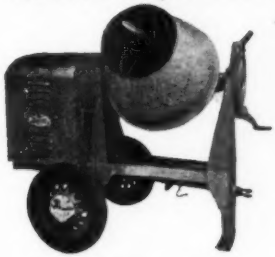

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THE HEAT ZONE

Your engine's heart zone is its heat zone—the top cylinder area. That's where vital valves must work—where heat is hottest—where sizzling temperatures scorch lubricants and leave bare metal unprotected . . . that's where Marvel Mystery Oil and the Marvel Inverse Oiler really go to work!

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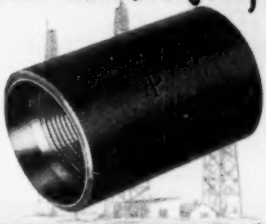

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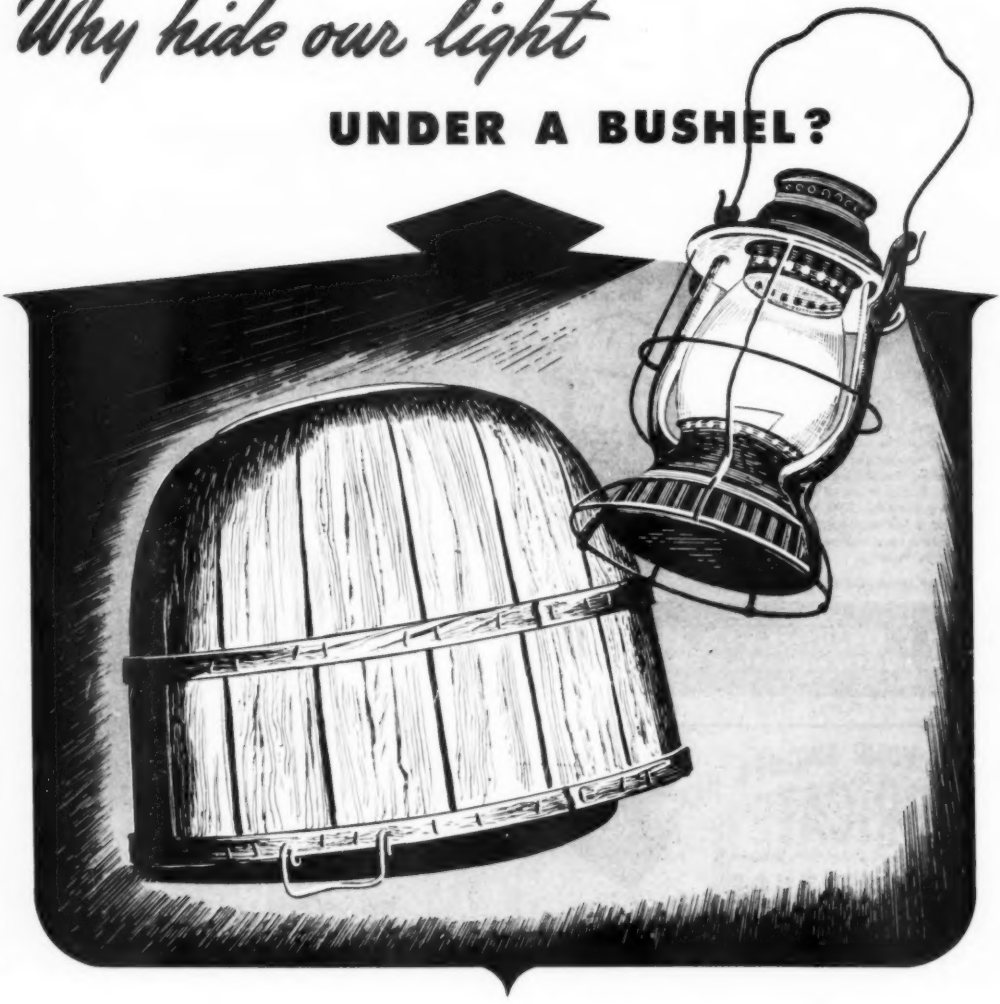

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Exploration and Drilling

Another Pre-Permian Strike for S.E. New Mexico

ANOTHER Devonian strike is almost certain for northwestern Lea County, New Mexico, as Amerada Petroleum Corp. 1-BTB State, NW NW 26-12s-33e, flowed as high as 89 bbl. per hour on 2½ hour drill-stem test from that pay.

On various drill-stem tests, this well has shown as follows: In the Pennsylvanian at 8,541-80 ft., open 4 hours, gas in 10 minutes, following 3 hours and 50 minutes, 4,900,000 cu. ft. of gas with 17 bbl. of distillate. At 8,788-8,862 ft., open 5 hours, oil to surface in 1 hour, flowed 69 bbl. of 44.8 -gravity oil (at 64° F.) in 4 hours; recovered 1,330 ft. of oil and 80 ft. of brackish water. At 8,860-8,939 ft., open 4 hours, recovered 5,940 ft. of salt water.

In the Devonian, a drill-stem test at 10,090-10,150 ft., with 1,000 ft. water cushion, open 5 hours, had gas in 56 minutes, water cushion in 57 minutes, and 59.0° (corrected) gravity oil (had more color than distillate) in 62 minutes. In 4 hours it flowed 182 bbl. of oil through a ⅝-in. bottom and 1-in. top chope. Drill pipe unloaded when pulled.

The best test was at 10,150-10,200 ft., open 3 hours. Gas and water cushion to surface in 25 minutes, oil in 30 minutes; flowed into pits few minutes, then gaged 222.6 bbl. of 57.7° -gravity oil (darker than previous test) in 2½ hours.

Final Devonian test at 10,199-250 ft., open 4 hours, recovered 360 ft. of water-cut mud, and 8,450 ft. of salt water. Well is being drilled on down and will probably be carried to Ellenburger, if the latter is present.

Tops reported for the 1-BTB are: Pennsylvanian 8,522 ft. (datum —4,263 ft.); Mississippian 9,865 ft., (datum —5,606 ft.); and Devonian 10,120 ft. (datum —5,861 ft.). Elevation is 4,259 ft.

This well lies about 4 miles south of Amerada's 1-BTA State, a strike previously covered. *(See The Oil and Gas Journal, March 17, 1949, p. 207, and April 28, 1949, p. 163).*

The 1-BTA State meantime has just recently been given final completion in the Devonian pay through perforations at 10,950-65 ft., (datum —6,715-30 ft.). On completion test it flowed 400 bbl. of 44.4 -gravity oil in 5½ hours, through ½-in. choke on tubing, or about 73 bbl. per hour. Earlier opinions by geologists that the second pay encountered in this well (it had a good test up in the Pennsylvanian) was Ellenburger, turned out to be wrong. When carried on down it encountered the top of the Simpson (Ordovician) at 11,604 ft. (—7,369 ft.), went into Ellenburger at 11,670 ft. (—7,435 ft.), and then into basement complex at 11,709 ft. (—7,474 ft.).

The BTA well is reported to have been located on what the seismograph showed to be a separate structure from the BTB well some 4 miles to the south.

The BTA had the Pennsylvanian at —4,400 ft., against —4,263 ft. for the BTB, which makes the BTB 137 ft. higher on that marker. The BTA had the Mississippian at —6,075 ft., against —5,606 ft. for the BTB, making the BTB 459 ft. higher there. The BTA had top of what is now known to be Devonian at —6,534 ft., against —5,861 ft. for the BTB, throwing the BTB 673 ft. high. Since the BTA had only 39 ft. of Ellenburger lying on the basement complex, it is difficult to say what the BTB will encounter below the Devonian. From the Pennsylvanian through the Devonian, the section appears to be thinning rapidly in the BTB, so it may not have much of an Ordovician section overlying the basement.

Indicated water levels in the BTB Pennsylvanian are reported to have been about 240 ft. higher than in the BTA. In the Devonian, the indicated water level is said to be about 820 ft. higher than in the BTA. This may indicate proof that the structures are separated by a saddle that will not produce. The mere remnant of Ellenburger found in the BTA may mean that the geology of this area is going to be pretty complicated by the time it is all worked out.

Charles J. Deegan.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

ROCKY MOUNTAIN AREA.—Husky Refining Co. recovered oil in the Madison at its Cedar Creek, Fallon County, Montana, wildcat, and has run casing to test. General Petroleum Corp. is testing its South Frisby, Wyoming, wildcat after running casing to top of Phosphoria at 10,575 ft.

NORTH LOUISIANA.—McAlester Fuel Oil Co.'s 1 Waller Estate, within the city limits of Bossier City, completed this week for 74 bbl. of high-gravity oil a day from the Pettit limestone.

WEST TEXAS.—Mitchell County's first Ellenburger producer, Superior 1 Dockery, completed late this week for 170.7 bbl. of 45 -gravity oil a day, plus some water, from open hole at 7,990-8,004 ft., after acid treatment. The flow was gaged through 11 64-in. choke, under 334 psi. pressure.

TEXAS GULF COAST.—Operators are preparing to run production test on Tide Water Associated Oil Co. 1 George Maguglin, Live Oak County wildcat, which promises to open a new pool. On drill-stem test at 7,795-7,807 ft. the well recovered 120 ft. of oil and gas-cut mud, plus 180 ft. of gas-cut mud and developed 170 psi. working pressure.

SOUTHWEST TEXAS.—A new oil pool has been opened by I. K. Howeth et al 1 Domingo L. Garza, approximately 1 mile southeast of Lockhart field production, Starr County. The well flowed 168 bbl. of net oil per day through 3/16-in. choke, plus 35 per cent water, through perforations at 4,034-36 ft. It is located in an area where only gas production has been previously developed.

KANSAS

Oil Production Is Proved In Three Kansas Wildcats

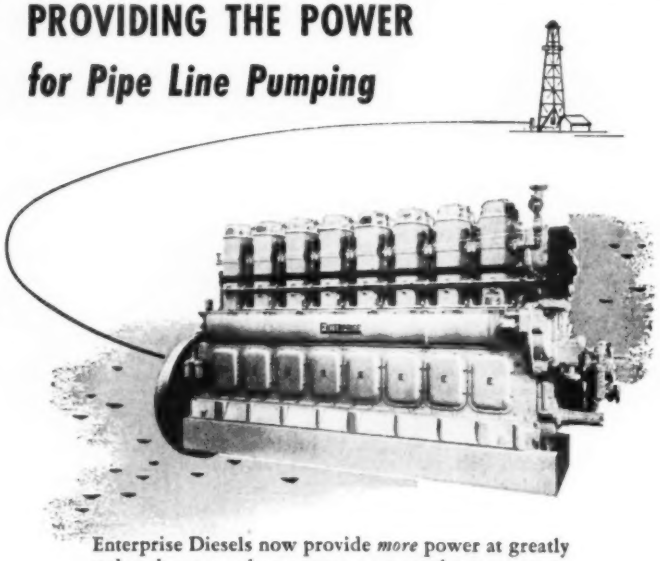
EL DORADO REFINING CO. is opening another good Arbuckle pool in its 1-B Stumps, NW NW SE 24-18-11, eastern Barton County, which swabbed and flowed at the rate of 35 to 40 bbl. per hour on initial production tests. Arbuckle was topped at 3,283 ft. (—1,511 ft.), and drilled to 3,299 ft. with casing at 3,285 ft. Nearest production is in the Ames pool, 2 miles to the west.

In northeastern Ellis County, J. M. Huber and associates 1 Chrisler, NW NW SW 22-11-16, 2 miles east of the Bemis-Shutts pool, established a potential of 54 bbl. of oil and 72 bbl. of water from the Lansing-Kansas City. Casing was perforated at 3,100-12 ft.

Musgrove Petroleum Corp. 1 Hart, SW SW NE 36-22-14, new pool opener in western Stafford County, swabbed an average of 20 bbl. of 34° oil per hour for 3 hours after a 500-gal. acid treatment in 2 ft. of Arbuckle pay at a total depth of 3,832 ft. Arbuckle was topped at 3,826 ft. (—1,900 ft.), but casing was run to 3,830 ft. Prior to acidizing, the well swabbed only 1 bbl. per hour. The discovery is 3 miles southeast of the Nellie pool.

Production of the rapidly developing Berland pool in southwestern Rooks County has been extended ½ mile westward by Glenn Nye 1 Sutor, SE SE SW 12-10-20. It has been given a potential rating of 100 bbl. per day with production from Arbuckle at 3,744-48 ft. (—1,562-63 ft.).

PROVIDING THE POWER
for Pipe Line Pumping



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KANSAS SUCCESSFUL WILDCAT

Greenwood County: Ward McGinnis 1 Eastman, NE NW SE 8-26s-11e, pumped 30 bbl. of oil per day from Mississippian at 1,865-78 ft., TD.

KANSAS WILDCAT FAILURES

Ellis County: Jones, Shelburne & Farmer 1 Graff, SW SW SW 1-13s-17w, dry, TD 3,745 ft., anhydrite 1,220 ft., Heebner 3,280 ft., Lansing 3,311 ft., conglomerate 3,610 ft., Arbuckle 3,715 ft.

Ellsworth County: A. B. & W. Drilling Co. 1 Zajic, SW SW SW 30-16s-10w, dry, TD 3,370 ft., Heebner 2,989 ft., Lansing 3,012 ft., conglomerate 3,325 ft., Arbuckle 3,341 ft.

Graham County: J. W. Braden Drilling Co. 1 DeBoer, NW NW NE 36-8s-22w, dry, TD 3,733 ft., Heebner 3,340 ft., Kansas City 3,371 ft., Arbuckle 3,724 ft.

Reno County: Vickers Petroleum Co. 1 Krouse, SE SE NW 26-25s-8w, dry, TD 3,750 ft., Lansing 3,187 ft.

Rooks County: Hinkle Oil Co. 1 Dahna, NW NW NW 15-10s-18w, dry, TD 3,847 ft., anhydrite 1,551 ft., Heebner 3,379 ft., Toronto 3,388 ft., Lansing 3,427 ft., conglomerate 3,686 ft., Arbuckle 3,788 ft.

Stafford County: M. B. Armer 1 Korzuszkiewicz, NE NE NE 16-23s-11w, dry, TD 3,787 ft., anhydrite 530 ft., Lansing 3,305 ft., conglomerate 3,647 ft., Viola 3,660 ft., Simpson 3,695 ft., Arbuckle 3,757 ft.

J. D. Ferrell Drilling Co. 1 Piepmeier, SE SE NW 17-24s-11w, dry, TD 4,021 ft., anhydrite 570 ft., Kansas City 3,420 ft., Viola 3,825 ft., Simpson 3,910 ft., Arbuckle 4,006 ft.

WESTERN NEBRASKA SUCCESSFUL WILDCAT

Cheyenne County: Ohio Oil Co. 1 Egging, NE NE NE 11-15n-49w, pumped 15 bbl. of 35°-gravity per hour from Muddy (?), topped at 4,401 ft., TD 4,429 ft.

APPALACHIAN FIELD

Gas Wells Highlight Week's Operations

PITTSBURGH. — In Georges Township, Fayette County, Pennsylvania, two deep wildcats reached the completion stage. Manufacturers Light & Heat Co. 8 Barton estate is being tubed; final open flow was 219,000 cu. ft. after acidizing. The total depth of 10,312 ft. made this the deepest cable tool well drilled, however, it was plugged back to a total depth of 7,257 ft. Orville Eberly et al 1 John Dulick gaged 184,000 cu. ft. after acidizing; total depth 7,786 ft. A good shallow sand gas well was was reported in Conemaugh Township, Indiana County, at J. J. Daub et al 1 McCurdy & McMillen, with 1,356,000 cu. ft., total depth 1,481 ft.

In Pocatalico district, Putnam County, West Virginia, Columbian Carbon Co. completed a fair gas well, 1-1121 L. A. Landers, for 1,860,000 cu. ft.; Corniferous lime 4,830 ft., Oriskany sand 4,918 ft., gas 4,922-38 ft., total depth 4,938 ft. A good shallow sand gas well was reported in Harvey district, Mingo County, at United Fuel Gas Co. 32-6447 Henry Closterman, which gaged 1,100,000 cu. ft. in the salt sand, total depth 1,378 ft. In wildcat drilling, United Fuel Gas Co. 1-6478 A. W. Hicks, Beaver Pond district, Mercer County, elevation 2,834 ft., reported gas at 3,183-87 ft. in volume of 47,000 cu. ft., which blew down to 26,000 cu. ft.; drilling is at 3,278 ft. In Glade district, Webster County, Hope Natural Gas Co. 9227 West Virginia & Pittsburgh Railroad Co., elevation 2,512 ft., recorded the Onondaga chert at 7,134 ft.

SOUTHWESTERN PENNSYLVANIA SUCCESSFUL WILDCATS

Fayette County, Georges Township: Manufacturers Light & Heat Co. 8 Barton estate, elev. 2,314 ft., 219,000 cu. ft. of gas after acidizing, Onondaga lime 7,100

ft., chert 7,145 ft., gas 7,194 ft., Oriskany sand 7,303 ft., TD 10,312 ft., PB 7,257 ft. Orville Eberly et al 1 John Dulick, elev. 2,415 ft., 184,000 cu. ft. of gas after acidizing, Onondaga chert 7,097 ft., gas 7,119, 7,129 and 7,158 ft., Oriskany sand 7,249-7,350 ft., TD 7,786 ft.

OKLAHOMA

Noble County Wildcat Gets Good Oil Recovery on Test

RECOVERING 935 ft. of clean oil and 835 ft. of oil-cut mud in a drill-stem test of the first Wilcox sand encountered at 5,162-95 ft., Schermerhorn Oil Corp. appears to have discovered another good pool in its 1 Brand, SE NE NE 18-21n-1w, a wildcat northwest of the Sams pool in Noble County. In the test, with the testing tool open 1 hour, gas showed in 8 minutes and flowed at the rate of an estimated 100,000 cu. ft. per day. No water was evident. At latest report, operators were running casing to complete.

Faultline Oil Co. and Viersen & Cochran also have what may prove to be the discovery well of a new pool in Cleveland County in their 1 Bruesch, C NW SE 2-9n-2w, 4½ miles northwest of Norman. Good saturation was found in a basal Pennsylvanian sand at 6,559-95 ft., and in a 2-hr. drill-stem test of the zone, a recovery of 255 ft. of oil-cut mud was made after tool had been open 2 hours. Hole, however, is being deepened to contract depth of 7,550 ft.

About 1½ miles southeast of the Prague pool in Pottawatomie County, another wildcat is showing for a small producer from the Hunton lime. It is Sterling Oil Co. 1 White, NE SW NE 9-11n-6e. Drill-stem tests were made of three intervals, 4,302-23 ft., 4,315-23 ft., and 4,351-56 ft., respectively. In the first, 155 ft. of oil-cut salty, muddy water was recovered. In the second, the recovery was 165 ft. of oil-cut mud with about 30 ft. of oil and gas-cut salty mud. The third got only 130 ft. of salty mud and water. After drilling to 4,690 ft. in the second Wilcox sand, topped at 4,685 ft., casing was run and will be perforated in the Hunton.

Gulf Oil Corp. 1 Foster, NW NW NE 23-13n-8e, first confirmation test for, and southeast offset to the discovery well of the new Rosenwald Cromwell sand pool in Okfuskee County, flowed 714 bbl. of oil in 13 hours through ¾-in. choke on completion test. Gas production was at the rate of 500,000 cu. ft. per day. It has the sand at 3,451-55 ft. The pool was opened in June by Falcon-Seaboard Drilling Co.

OKLAHOMA SUCCESSFUL WILDCAT

Seminole County: McIntyre 1 Harjo, NE SE NW 35-9n-7e, pumped 20 bbl. of oil per day from Booch at 3,317-34 ft., TD 3,445 ft.

OKLAHOMA WILDCAT FAILURES

Cimarron County: Deardorf 1 Wiggens, SE NE SE 24-4n-8ecm, dry, TD 4,735 ft., Keys 4,632 ft., Mississippian 4,660 ft.

Cotton County: Bolin 1 Collins, NE NE SE 32-2s-9w, dry, TD 2,690 ft.

Albritton 1 Moo-Ray-Waddy, NE NE NE 2-3s-12w, dry, TD 2,059 ft., Thomas 1,892-1,927 ft., 1,960-65 ft., and 2,015-27 ft., Megargel 2,050 ft.

Garvin County: Schneider 1 Lowery, C S 2 NE 24-4n-3e, dry, TD 1,120 ft.

Jefferson County: Jennings 1 Ellis, SE SE NE 34-5s-8w, dry, TD 4,183 ft., Arbuckle 4,070 ft.

Bridwell 1-A Smart, SE SE SE 11-7s-6w, dry, TD 2,095 ft., sand 1,540-70 ft., sandy lime 2,079-87 ft.

Kay County: Mee 1 Muret, SE SE NE 14-27n-1e, dry, TD 3,737 ft., Layton sand 2,903 ft., Checkerboard 3,011 ft., Big lime 3,200 ft., Peru 3,242 ft., Oswego 3,330 ft., Cherokee 3,491 ft., Prue 3,511 ft., Verdigris 3,538 ft., lower Skinner 3,607 ft., Red Fork 3,671 ft.

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225 Second Street, Benton Harbor, Michigan, U.S.A.

Pawnee County: Brockman 1 Leen, SE SE SW 14-20s-5e, dry, TD 3,785 ft., Layton 2,145 ft., Big lime-Oswego 2,910 ft., Verdigris 3,230 ft., lime 3,335 ft., Bartlesville 3,345 ft., Mississippi lime 3,597 ft., Woodford 3,716 ft., dolomite 3,774 ft., Wilcox 3,768 ft.

Payne County: Alpha Petroleum Co. 1 Dodson, NE NE SW 15-17n-1e, dry, TD 5,123 ft., Mississippi lime 4,626 ft., Woodford 4,672 ft., Hunton 4,711 ft., Sylvan 4,806 ft., Viola 4,894 ft., dense 4,950 ft., Wilcox 4,988 ft., second Wilcox 5,114 ft.

Pottawatomie County: Standard Seismograph 1 Lacquement, NE NW SE 3-11n-5e, dry, TD 4,881 ft., Hogshooter 4,881 ft., Checkerboard 2,517 ft., Oswego 3,350 ft., Prue 3,357 ft., broken sand 3,412-50 ft., sand 3,618-3,748 ft., Inola 3,943 ft., brown lime 4,065 ft., Hunton 4,555 ft., Sylvan 4,646 ft., Viola 4,737 ft., Wilcox 4,800-50 ft., second Wilcox 4,867 ft.

Seminole County, Johnson 1 Harris Foundation, NE SE SW 5-6n-6e, dry, TD 4,228 ft.

Murta 1 Jackson, NW NE SW 26-7n-7e, dry, TD 2,674 ft.

TEXAS GULF COAST

Oil Production Confirmed In East Village Mills

HOUSTON—Oil production in East Village Mills field, Hardin County, has been confirmed with completion of Houston Oil Co. of Texas 1 Charles Kuderer, which flowed 256 bbl. of 41.2 -gravity oil per day through 10 64-in. choke. Completion was made through perforations at 7,052-60 ft. with 1,100 psi. pressure on the tubing.

Tide Water Associated Oil Co. 1 Geo. Maguglin, wildcat in Live Oak County, promises to open a new field in South Texas, and operators are now preparing to run production test. Total depth of the well is 8,546 ft. with 5½-in. casing set to 8,545 ft. On drill-stem test at 7,795-807 ft., the well recovered 120 ft. of oil and gas-cut mud, and 180 ft. of gas-cut mud and developed 170 psi. working pressure. Other shows were logged farther down the hole in Massive Wilcox, and it is likely these zones will be tested before completion attempt is made.

A new pool is being opened in Lavaca County, with completion of Great Lakes Carbon Corp. 1-A Allen, in William Bell Survey, 2 miles east of Provident City gas and condensate field. On a 30-minute drill-stem test, the well recovered 510 ft. of 41.5 -gravity oil plus some fresh water through ½-in. choke from 6,112-20 ft. and developed 100 psi. working pressure. Total depth of the well is 6,160 ft., and pipe is being set for completion.

Sinclair Oil & Gas Co. has staked location for a 11,500-ft. Wilcox sand wildcat test in Lake Creek area, Montgomery County. Operation is 1 H. N. Grogan in Archibald Hodge Survey, Abstract 18, 8 miles southwest of Conroe.

McCarthy Oil & Gas Corp. 1 Rev. C. E. Byrne, in North Big Hill area, Jefferson County, has been completed as a gasser. Hole was drilled to a total depth of 10,536 ft. and plugged back to 3,845 ft. to sidetrack. In the sidetracked hole, gas sand was hit at 8,107 ft. Shut-in pressure is 3,250 psi.

TEXAS GULF COAST (DISTRICTS 2 & 3) SUCCESSFUL WILDCATS

Goliad County: New pay, at West Weesatche—W. L. Goldston 1 Elsie Landgrebe, in M. J. Carico Sur., A-90, 3 miles S of Weesatche townsite, top sand 8,060 ft., TD 8,150 ft., perf. 8,060-75 ft., gas-condensate, no gage, SIP 2,900 psi.

Hardin County: Oil discovery, Houston Oil Co. of Texas 1 Charles Kuderer et al Unit, at East Village Mills, in Geo. Brown Heirs Sur., A-74, top sand 7,052 ft., TD 7,290 ft., perf. 7,052-60 ft., IP: 256 bbl. oil per day, 10/64-in. choke, TP 1,100 psi., 41.2° gravity, GOR 594.

Live Oak County: New oil discovery—Argo Oil Corp. 1 Schulz Live Stock Co., in John Hefferman Sur., 5½ miles N of Three Rivers, top sand 8,314 ft., TD 9,500 ft., perf. 8,314-40 ft., IP: 9 bbl. condensate per day plus 125 M.c.f. gas per day, ⅛-in. choke, TP 400, CP 700, grav. 49.5°, GOR 13,359.

TEXAS GULF COAST (DISTRICTS 2 & 3) WILDCAT FAILURES

Bee County: Hewit & Dougherty et al 1 A. C. Jones, in Jas. Hefferman Gr., 1½ miles N of Beeville, dry, TD 3,820 ft.

Brazoria County: H. L. Hunt 1 Geo. M. Bailey et al, in G. Logan Sur., A-80, 8 miles W of Alvin, dry, TD 9,815 ft.

Calhoun County: John W. Mecom 1 Minnie S. Welder, in Rios Sur., A-32, 1½ miles SE of Heyser field, dry, TD 9,856 ft.

Galveston County: Newman Bros. 1 F. L. Roberts, in BS&F Sur., 3 miles E of Hastings, dry, TD 8,600 ft.

Jackson County: Lion Oil Co. 1 Kazmir, in W. H. Clary Sur., 40, 2½ miles E of Maurbro field, dry, TD 6,016 ft.

Matagorda County: H. L. Hunt 1 D. H. Bramen et al, in Jno. Crier Lge., A-19, 6½ miles NW of Bay City, dry, TD 8,640 ft.

Refugio County: Southern Minerals Corp. 2 T. F. West et al, in J. Coughlin Sur., A-18, 6 miles N of Refugio, dry, TD 6,015 ft.

Southern Minerals Corp. 1 Mary F. Woodworth, in J. & J. J. Garcia & J. Vidauri Sur., 1¼ mile NE of Vidauri, dry, TD 6,015 ft.

Victoria County: Western Natural Gas Co. 1 Fritz Berger, in Benjamin J. White Sur., A-345, 5¼ miles SW of Mission Valley, dry, TD 9,128.

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Fig. F533 Fig. F538

SPANG TUBING SPEAR
(Fig. F533)

SPANG TRAP SOCKET
(Fig. F538)

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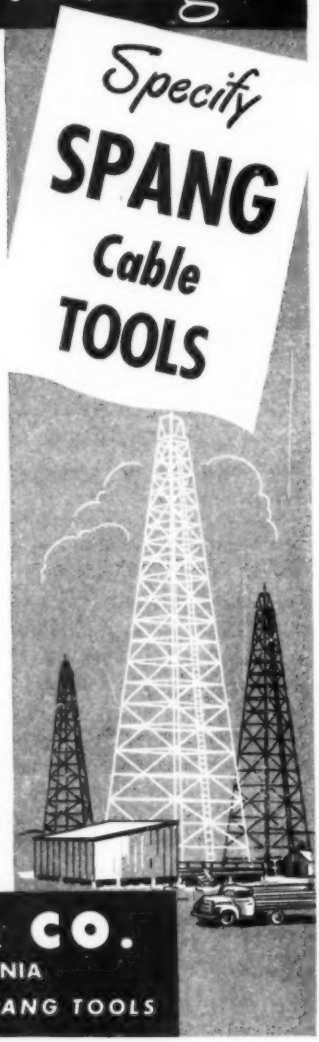

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EASTERN TEXAS

Prospective Discoveries Loom in Woods County

DALLAS—Wood County had three prospective pool openers in various stages of completion this week. Three miles northwest of Mineola, Bobby Manziel 1 W. D. Cain, S. Yarbough Survey, was installing pump to test perforations in the sub-Clarksville at 4,736-52 and 4,761-68 ft. Field reports credited the well with swabbing oil and wash water, with fluid level standing 2,000 ft. from the surface. Total depth was 4,790 ft.

Shell Oil Co., Inc., 1 Consumers Lignite Co., Friend McMahan Survey, 2 miles south of Alba, plugged back from 4,746 to 4,189 ft. and was installing pump. It swabbed clean oil from perforations at 4,153-70 ft., although recovery was not reported. Operators estimated the well would pump from 70-100 bbl. of heavy oil a day.

In central Wood County, 4 miles west of Mineola, F. B. Jackson 1 Joe Car, James Colson Survey, was reported to have pumped 30 bbl. of 18°-gravity oil a day, from perforations at 4,612-38 and 4,644-52 ft.

Standard Oil Co. of Texas 1 Beth Brown, Strawn wildcat southeast of the Sherman field, took its 19th core of the Strawn at 4,642-52 ft., recovering 6 ft. of sandy shale with oil odor. Operators ran 7-in. casing to 3,650 ft. and perforated from 3,398-3,434 ft. and 3,440-50 ft. Total depth was 4,720 ft.

Carter-Gragg Oil Co. 1 Mrs. M. L. Levine, T. D. Frizzell Survey A-1,070, 3 miles northeast of Cayuga, was dry at 4,971 ft., with no shows reported. It logged the sub-Clarksville at 4,558 ft., which had some water, and the Woodbine at 4,928 ft.

In Sabine County, 9 miles northeast of Hemphill, Humble Oil & Refining Co. 1-B Minton, Shadrich Morris Survey, A-42, was waiting on cement after running 10¾-in. casing to 6,246 ft. with 200 sacks.

EAST TEXAS (DISTRICTS 5, 6 & 6-P) WILDCAT FAILURES

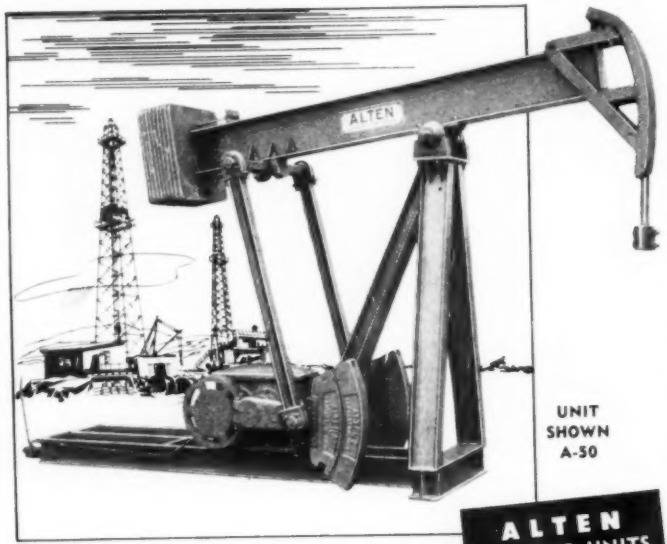
Denton County: J. M. Hickey & Sons 1 B. B. Forester, W. Wilson Sur., A-1381, 2½ mi. NW Bolivar, dry, TD 2,070 ft., show of oil 1,676 ft.

Houston County: Ralph M. Ballard 1 Mary J. Cutler, G. W. Wilson Sur., 3½ mi. W Weches, dry, TD 5,837 ft., Woodbine 5,700 ft., Travis Peak, 5,802 ft. by samples, no shows.

Morris County: Ray Holbert 1 Lula Connor, T. B. Edmondson Sur., 2 mi. N Cason, dry, TD 4,516 ft., Woodbine 4,125 ft., elev. 453 ft.

Robertson County: Magnolia Petroleum Co. 1 Mary Koperczak, A. B. Fairh Sur., A-150, 2 mi. SE Bremond, dry, TD 5,400 ft., no shows.

Upshur County: Barney Carter 1 G. F. Landford, Wm. B. Mathis Sur., 3 mi. W Kelsey, dry, TD 5,840 ft., PB 5,690 ft., Pecan Gap 2,680 ft., Austin 3,880 ft., Woodbine 4,133 ft., Georgetown 4,590 ft., Paluxy 5,710 ft., by samples, elev. 452 ft.



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CALIFORNIA

Carrizo Plains Wildcat Fails on First Test

LOS ANGELES—The Carrizo Plains wildcat, 53-36 Producers, has failed to produce on first formation tests. The well is the joint project of Gene Reid, Independent Exploration Co., and Universal Consolidated Oil Co. So far results parallel the findings of other attempts to locate production in this area. Sands were found but no oil.

Encouraging reports had been received on this well during the last 2 weeks. At least 220 ft. of oil sand was located at 1,562-1,782 ft. The upper third of the sand was tight but the lower 135 ft. was said to be well saturated. However, swabbing and bailing operations failed to recover oil, gas, or water. Liner is being pulled and the well will be deepened. The equivalent formation in an adjoining test by this group, 67-36 Temblor-Rexroth, will most likely not be tested. This well is now drilling beyond 3,400 ft.

Following the completion of its gas well, 1 Corning Community, in Tehama County, Buttes Oilfields, Inc., has set location for a third well in the northwest corner of 1-24n-3w. The second well, 1-A Corning Community, is running casing at 1,607 ft.

General Petroleum 1 Circle J, in the Newhall area, was given a formation test at 5,868-5,968 ft. The well was open 3 hours and recovered 200 ft. of gassy mud, a trace of oil, and no water. The well is being cleaned and will be deepened.

Standard Oil Co. of California has completed water shutoff at 12,280 ft. in its 45 Van Sicklin at Lost Hills. The well is being drilled by Rocky Mountain Drilling Co. and now stands at 14,596 ft.

Another California Standard test at Kettleman Hills-South Dome, 4-2 S. F. & F. L., 12-25s-19e, has pulled casing from the lower section. Depth was 12,954 ft. An attempt to get production will be made around 9,500 ft. In the Middle Dome area of Kings County, the same company's 68-4Z S. F. & F. L. is now bottomed at 11,925 ft. A plug has been set at 10,750 ft., following a test of the 10,800-11,925-ft. interval. The test gave a flow of salt water. The casing is now perforated at 10,470-10,640 ft. and a test of this interval will be made.

General Petroleum Corp. has completed its first development well in its recently discovered Calder field. The well, 41-26 Sturdevant, topped the oil sand at 8,772 ft. and bottomed at 8,824 ft. This is about twice the amount of sand found in the discovery well. Production is 310 bbl. of 25.6°-gravity oil per day, with tubing pres-

sure at 1,110 psi. The company's 74-24 KCL Calder is drilling at 7,180 ft.

CALIFORNIA SUCCESSFUL WILDCAT

Tehama County, Flournay area: Buttes Oilfields, Inc., 1 Corning Comm., 1-24n-3w, perf. 1,406-49 ft. and 1,449-1,524 ft., flowed 5,170,000 cu. ft. of gas at 530 psi. from upper zone, 5,070,000 cu. ft. at 592 psi. from lower zone, shut in at 600 psi.

CALIFORNIA WILDCAT FAILURES

Glenn County, Willows area: Shell Oil Co., Inc., 1 James, 1-19n-5w, dry, TD 10,201 ft., elev. 340 ft.

Kern County, Blackwells Corner area: The Superior Oil Co. 5 OLC, 26-26s-19e, dry, TD 5,999 ft., elev. 675 ft.

Comanche Point area: B. C. Mackey 1 Swett-Barkley, 34-12n-18w, top Santa Margarita 428 ft., dry, TD 768 ft., elev. 933 ft.

B. C. Mackey 1 Tejon Creek, 31-32s-30e, dry, TD 846 ft., elev. 904 ft.

San Joaquin County, Rio Vista area: Brazos Oil & Gas Co. 1 Brown, 22-4n-4e, Domengine 3,652 ft., Emigh sand 3,707 ft., Midland sand 4,395 ft., dry, TD 5,500 ft.

ROCKY MOUNTAIN

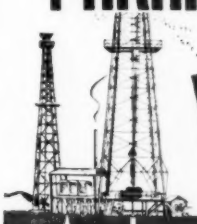
Well on Cedar Creek Anticline Shows Oil

DENVER—Oil was recovered in the Madison on drill-stem test of Husky Refining Co. 1 Northern Pacific, CNE NE 7-4n-62e, on Cedar Creek anticline, Fallon County, eastern Montana. The test was made between 6,810-34 ft., with Madison topped at around 6,817 ft. Husky is now running casing on the well for further tests, after recovering 1,775 ft. of oil in 33 minutes. The Madison discovery well on this structure was drilled by Montana-Dakota Utilities Co. in 1946, with the well making an initial of 300 bbl. daily from that formation. However, production was not sustained and the well was later shut down after producing 28,144 bbl. Carter Oil Co. drilled a deep test on the structure in 1941 and this well went to 9,680 ft., total depth, in pre-Cambrian, after finding saturation in Madison and Ordovician beds. Husky acquired deep rights under the unit, which covers some 100,000 acres along the eastern Montana-western North Dakota line, and plans additional drilling if production is satisfactory from the present well.

At General Petroleum Corp. South Frisby wildcat, 37-X-24-G, NW SE SW 24-47n-92w, Washakie County, Wyoming, tubing has been run and operator is preparing to test the well in Phosphoria at 10,665 ft., total depth. Saturation was logged in the Phosphoria below 10,575 ft., and the well is expected to make a discovery in the area. This unit adjoins on the southeast Pure Oil Co. Worland Unit, where there are now 15 wells producing from the Phosphoria below 10,000 ft. It is probable General Petroleum will acidize the well after initial tests. Casing has been cemented on top of formation. Location for this wildcat was based on seismic operations in the area, as were company's discoveries at South Fork and Sand Creek, south of South Frisby.

One of the most interesting wildcats to be drilled in recent years in Utah is Tide Water Associated Oil Co. 74-11, NW NW NW 11-26s-19e, on Big Flat Unit, Grand County. The well is now reported drilling and coring below 8,100 ft. in the Mississippian, which was topped at 7,935 ft. (?). This is the first well in this part of the extensive Salt basin of east-central and west-central Colorado, to go below the Paradox salt formation. Shows of oil were reported in the Mississippian, but on a recent drill-stem test the well made water from that formation. The operator will probably drill through Mississippian, another 500 ft., and then run casing for extensive tests of

PARAFFIN DEPOSITION



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shows in the Paradox salt, upper Paradox, and Hermosa sections. The well was located following surface and seismic work in the area, and if commercially productive will undoubtedly lead to considerable wildcat activity throughout the area. Large blocks are held by a number of major operators in the area and extensive geological work has been done. There are a number of large surface structures in this basin, most of which have been tested to the top of the Paradox.

Slight shows were reported in the Entrada at Pure Oil Co. interesting wildcat at Horse Fly Unit, CNE SW 14-46n-13w, Montrose County, Colorado, along the northeast flank of the Salt basin. The wildcat is now at 1,510 ft., total depth, with operator reaming to set casing before drilling deeper. The well is expected to test Pennsylvanian and possibly Mississippian prior to completion. This location is on a structure lying southwest of a major fault paralleling the Uncompahgre uplift and there was extensive leasing along this fault northwest from Horse Fly to the Utah line, a distance of more than 75 miles. Continental Oil Co., J. H. Huber Corp., Lion Oil Co., and many others hold blocks in the area, as well as Pure and outcome of the present well will have considerable effect on drilling prospects in the area.

WYOMING WILDCAT FAILURE

Lightning Creek, Niobrara County: Atlantic Refining Co. 2 State 36, CSE SE 36-35n-66w, 1,791 ft. TD, plugged and abandoned. Basal Niobrara Unconformity 587 ft., Frontier 679 ft., Mowry 1,447 ft., Muddy 1,735 ft., Muddy sand 1,766 ft.

MONTANA SUCCESSFUL WILDCAT

Clark Fork, Carbon County: British-American Oil Prod. Co. 1 Govt.-McClellan, 9,446 ft. TD, completed for 2,244 M.c.f. gas and 31 bbl. distillate (57.7° gravity) per day from Dakota perforations 7,548-60 ft., Virgelle 4,296 ft., Telegraph Creek 4,397 ft., Elk Basin 4,524 ft., Colorado 4,583 ft., Frontier Formation 5,990 ft., Basal Frontier 6,406 ft., Mowry 6,470 ft., Muddy 7,230 ft., Cloverly 7,440 ft., Dakota 7,550 ft., Lakota 7,635 ft., Morrison 7,673 ft., Sundance 8,013 ft., Gypsum Springs 8,445 ft., Dinwoody 9,003 (?) ft., Phosphoria 9,030 (?) ft., Tensleep 9,093 ft., Amsden 9,220 ft., Madison 9,393 ft. Location: C NE NE 26-9s-22e.

MISSISSIPPI

Tenth Well Staked In Bude Field

JACKSON.—California Co. has staked a northwest offset to 1 Nan Bridley, second producer in Bude field, Franklin County, after somewhat of a slack in activity in the field. Location of the offset is approximately center SE SE 19-5n-4e. Projected depth of the well is not known, but of the nine wells drilled in Bude field, the average footage per well is 11,216 ft.

C. Porter Johnson, of Laurel, Miss., is moving in rig to drill a wildcat test in Jasper County, 34-4n-12e. Location is approximately 3 miles north of Southland Co. - Southport Petroleum Co. 1 Maske, which was drilled to 6,165 ft. (Lower Cretaceous) and completed as dry in 1944.

Stanolind Oil & Gas Co. is preparing to complete 1 J. B. Dockery, irregular 17-10n-2e, Jefferson County, which tested approximately 17 bbl. of oil per hour through perforations at 9,746-52 ft. and 9,768-75 ft. In attempt to set packer for dual completion, tubing twisted off and operators are now fishing for packer and 3,060 ft. of tubing.

ALABAMA WILDCAT FAILURE

Houston County: Union Producing Co. 1 Kirkland, 20-7n-11w, dry, TD 8,100 ft.

MISSISSIPPI WILDCAT FAILURES

Adams County: D. C. Latimer-Red Wing Drilling Co. 1 Craig Estate, 3-6n-2w, dry, TD 6,510 ft.

L. M. Lockhart 1 Mrs. L. B. Scheffel, 46-6n-2w, dry, TD 7,016 ft.

Greene County: Humble Oil & Refining Co. 1-B Board of Supervisors, 16-5n-8w, dry, TD 8,500 ft.

MICHIGAN

Dual Pay Found In Essexville Extension

MOUNT PLEASANT.—Basin Oil Co. appeared to have extended Essexville Dundee oil pool, Bay County, to the east as both a Kawkawlin horizon pay and the conventional Essexville pay section was drilled in the 1 Badour-Fritch Commission, SW NE SW 15-14n-6e, Hampton Township, Bay County.

This semioutpost bid, the furthest east test drilled in this old pool, showed about 2,000 ft. of free oil natural at a total depth of 2,885 ft. After about 48 hours, hole had filled to flow point and appeared to be good for about 50 bbl. of oil a day natural. The Essexville well was higher than older producers to the west on the Dundee objective, and was one of very few wells in the pool to show commercial prospect in the Kawkawlin pay. Top of objective Dundee was logged at 2,659 ft. and pays showed between 2,773-85 ft. and 2,880-83 ft.

After coring an oil porosity zone in the Traverse between 2,914-29 ft., Rex Oil & Gas Co. 1 Cox, SE SW SE 21-16n-10w, diagonal northeast offset to the Paris field discovery well, Green Township, Mecosta County, set 5-in. casing for completion in that horizon. Earlier plans to drill to the Reed City zone were abandoned.

MICHIGAN WILDCAT FAILURES

Lake County, Chase Township: Samuel S. Garfield 1 Blank, NW NE NW 23-17n-11w, Monroe 3,701 ft., dry, TD 3,792 ft.

Mason County, Amber Township: J. O. Mutch 1 Bretschnider, C NE SE 19-18n-17w, Monroe 2,151 ft., dry, TD 2,245 ft.

Oceana County, Golden Township: Carter Oil Co. 1 Pearson, NE NE SE 15-15n-18w, Dundee 2,230 ft., dry, TD 2,356 ft.

Pentwater Township: Miller-Goff, Inc. 1 Hikes, SE SE SE 33-16n-18w, Monroe 2,238 ft., dry, TD 2,548 ft.

Osceola County, Richmond Township: H. E. Bell 1 Fuller, NE NE SE 30-17n-10w, Monroe 3,636 ft., dry, TD 3,737 ft.

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SOUTHWEST TEXAS

Lacy Area Discovery Makes 118 Bbl. Per Day

CORPUS CHRISTI.—Sidney H. Smith, Jr., has run potential gage on 1 O. W. Johnson, oil discovery in the Lacy area, Cameron County. The well flowed 118 bbl. of 45°-gravity oil per day through perforations at 7,547-50 ft. through 1/8-in. choke with tubing pressure of 1,000 psi. and casing pressure 2,400 psi. Total depth is 7,552 ft., with 5½-in. casing on bottom.

Sinclair Oil & Gas Co. John Jancik, wildcat, 4½ miles southwest of Alamo, Hidalgo County, has been dually completed for oil and gas-condensate production. The well flowed 5 bbl. of 43°-gravity oil per hour through 1/8-in. choke through perforations at 6,915-40 ft. with 70 psi. tubing pressure, and through new perforations at 6,825-55 ft., it flowed gas-condensate with 2,350 psi. working pressure; no gage as yet. Total depth is 9,215 ft., with 9⅝-in. casing set to 8,788 ft.

A southeast extention to Santa Fe field, Brooks County, has been made with completion of Humble Oil & Refining Co.'s Santa Fe Ranch, which gaged 2,850 M.c.f. of dry gas per day on open flow. The well was drilled to a total depth of 8,491 ft., and completion was made through perforations at 5,896-901 ft.

A new oil pool has been opened with completion of I. K. Howeth et al 1 Domingo L. Garza, 1 mile southeast of Lockhart field oil production, Starr County. It flowed 168 bbl. of net oil per day through 3/16-in. choke, plus 35 per cent water, through perforations at 4,034-36 ft. The well lies in Porcion 80, 10 miles northeast of Rio Grande City, and is in an area where only gas production has been previously developed.

Humble Oil & Refining Co. has abandoned 1 R. J. Kleberg, Jr., Trustee, wildcat 7 miles east of Encino, at 10,149 ft. after an unsuccessful fishing and milling job, with 5½-in. casing set on bottom. Pipe collapsed and made testing impossible. A number of drill-stem tests shows were made farther up the hole, while drilling. The well is located in Santa Quiteria Grant, Brooks County.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) SUCCESSFUL WILDCATS

Hidalgo County: New pay and extension at McAllen, Coastal Refineries, Inc., & Mayfair Minerals, Inc., 1 O. H. Pagelson, ¾ mile S of Pharr, just SE of McAllen field, top sand 9,370 ft., TD 10,395 ft., perf. 9,370-410 ft., IP: 25,000 M.c.f. gas per day open flow, GCR 47,280, SIP 6,900 psi., comp. 6-21-49.

Nueces County: New pay, at Minnie Bock, Atlantic Refining Co. 1 W. S. Gandy, in J. Lopez de Herrera Sur., G. H. Paul subdivision, top sand 5,487 ft., TD 7,250 ft., perf. 5,488-94 ft., IP: 36 bbl. oil per day open flow, GOR 500, TP 10-50, CP 460, grav. 18.4°, comp. 6-18-49.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) WILDCAT FAILURES

Brooks County: Sun Oil Co. C-1 Mary M. Lasater, in AB&M Sur. 289, 2½ miles W of Gyp Hill field, dry, TD 8,930 ft.

Duval County: Flour Bluff Oil Corp. & Cox and Hamon 1 M. Weatherby et al, in BS&F Sur. 89, A-109, 2 miles NE of Terancahuas field, dry, TD 2,900 ft.

Duval County: Trio Oil Co. 1-B Farmers Life Ins. Co., in Sur. 320, 6 miles SE of Seven Sisters, 1½ mile W of Strake field, dry, TD 3,897 ft.

Duval County: Frand P. Zoch, Jr., et al 1 John Dunn, Sur. 454, 5½ miles SW of Conoco Driscoll field, dry, TD 4,516 ft.

Jim Hogg County: Dulaney Oil Co. 1 R. Holbein et al, in Las Animas Gr., 15 miles S of Mirando City, dry, TD 2,367 ft.

Travis County: Tra-Tex Oil Corp. 1 Nelson Bros. in William Lewis and P. Harrison

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Webb County: O. W. Killam 74 Bruni Estate, in Arispe grant, 3 mile SW of Bruni, dry, TD 2,727 ft.

N. CENTRAL TEXAS

Cities Service Offset Flows 18 Bbl. on Test

WICHITA FALLS.—Cities Service Oil Co. 1 Tully, G. W. Isabell Survey, northwest Wise extension well to the Chico area and an east offset to a Jack County conglomerate discovery, flowed 18 bbl. of oil and 65 bbl. of fresh water in 7 hours, from bottom of pipe at 5,872 ft. to 5,919 ft., total depth. The production section is reported as the deepest pay found thus far in any of the wells from Chico to northeastern Jack County. Previous to the 2,000-gal. acid treatment, the well flowed at the rate of 5-6 bbl. of oil an hour. It was drilled with fresh water during the last 50 ft. of penetration which was thought to account for the water being produced with the oil. Gas flow was estimated at 3,700,000 cu. ft. daily. On an elevation of 1,029 ft., the Caddo top was logged at 5,162 ft. Location of the well is about 1 mile west of nearest production in the Chico field.

Archer County.—Jack L. Story 1 T. R. Coleman, Ellenburger test 3 miles north of Scotland in the Coleman Subdivision, Block 22, was drilling below 2,972 ft. in shale. Location is 3 miles south of Strawn production in the Vogtsberger field.

W. C. Young 1 Turner, Section 16, Crawford Pasture Subdivision, had total depth at 4,908 ft., in the Caddo topped at 4,572 ft. Testing was started down the hole, with the first drill-stem test in the Cisco at 1,244-52 ft. In 2 hours the recovery was 120 ft. of drilling mud.

Baylor County.—American Liberty Oil Co. 1 J. S. Criswell, Section 97, T&NO Survey, had total depth at 5,575 ft. and was preparing to test. It is an Ellenburger wildcat, 8 miles southwest of Seymour, on which details have not been reported. Field sources made a preliminary estimate of 20 bbl. of oil a day.

Cooke County.—Kay Kimbell 1 R. M. Crump, W. A. J. Finch Survey, A-382, Ellenburger wildcat 8 miles east of Gainesville and 1 mile northeast of Strawn production in the Woodbine field, was drilling ahead after testing a show of oil at 3,702-09 ft. A 1-hour drill-stem test produced a light blow and recovered 30 ft. of oil-cut mud, 90 ft. of heavily oil-cut mud, and 180 ft. of oil-cut salt water. Flowing pressure was 85 psi. and bottom-hole pressure was 1,500 psi. The section tested was Strawn.

Kimbell's 1 W. E. Winger, Section 81, Fannin CSL, 3 miles northeast of Callisburg, had total depth at 5,867 ft., in sand, and was swabbing. First drill-stem test of the Strawn at 5,861-67 ft., open 30 minutes, recovered 3,700 ft. of gas, 180 ft. of oil and 60 ft. of oil-cut mud. Recovery on the swab was not reported. Fluid was said to be standing at 3,000 ft.

Jack County.—Jack Grace Production Co. 1 T. H. Cherryhomes, T. Henry Survey, A-264, 2 miles northeast of Cundiff, was dry at 5,868 ft., still in the conglomerate. Top of the Caddo was 5,360 ft. The well was reported as a 7,000-ft. Ellenburger wildcat.

Mid-Continent Petroleum Corp. 2-A Boyd, S. H. Hazel Survey, A-258, topped the Ellenburger at 6,180 ft., on an elevation of 1,007 ft., and was drilling ahead at 6,242 ft. First drill-stem test of the Ellenburger at 6,190-6,242 ft., open 90 minutes, recovered 30 ft. of mud. Location is 3 miles south of Post Oak, and about 2 miles southeast of nearest Ellenburger production in the Post Oak field.

Mid-Continent 1 T. E. Davis, J. J. Shelton Survey, A-596, 4 miles west of Cundiff, was drilling at 5,703 ft. in shale and conglomerate, after making extensive drill-stem tests in the Caddo conglomerate, most of which recovered gas-cut mud.

C. J. Simpson 1 Lydia Chipman, R. Barr Survey, A-62, 3 miles northeast of Cundiff and $2^1/_2$ miles north of new Caddo production, flowed 18.6 bbl. of 43°-gravity oil a day on 3/16-in. choke. Tubing pressure was 100 psi. On 7 32-in. choke it made 22 bbl. of oil a day.

Nolan County.—Skelly Oil Co. 1 E. A. Ater, prospective Ellenburger discovery $3^1/_2$ miles southwest of Rosco, had total depth at 7,155 ft. and prepared to perforate after squeezing holes at 7,090-7,100 ft., which produced 91 bbl. of oil and 78 bbl. of salt water in the first 24 hours of swabbing. In the next 17 hours of swabbing, the recovery was nearly all salt water.

Sweetwater Exploration Co. 1 W. W. Davis, 165-1A-H&TC, $6^1/_2$ miles east of Maryneal, was drilling dolomite at 6,666 ft. No drill-stem test had been reported below 5,546-60 ft., which recovered 30 ft. of oil and 120 ft. of heavily oil and gas-cut mud.

NORTH CENTRAL TEXAS (DISTRICTS 9 & 7-B) SUCCESSFUL WILDCATS

Jack County: Hanlon-Boyle, Inc., 1 J. R. Dodson, J. W. Williams Sur. A-877, 7 mi. S Antelope, flowed 168 bbl. 41°-gravity oil 13 hr., 16/64-in. choke, Caddo 4,536-70 ft., TD, GOR 850 cu. ft., TP 500 psi., CP 1,140 psi., elev. 1,023 ft.

Wichita County: Roy H. Lebus 1 Will Burnett, W. Williams Sur., A-385, 3 mi. SW Iowa Park, pumped 5 bbl. oil a day, TD 1,460 ft., top pay 1,455 ft.

Wise County: Signal Oil & Gas Co. et al 1 Henry Horton Unit 2, NW NW G. A. Frazier Sur., 48, A-893, $6^1/_2$ mi. N Springtown, flowed 192 bbl. 33°-gravity oil a day, 10/64-in. choke, Caddo perforations 3,835-80, 3,880-85 ft., GOR 1,600 cu. ft., CP 500 psi., TP 280 psi., top Caddo 3,675 ft., TD 6,590 ft., PB 3,900 ft.

NORTH CENTRAL TEXAS (DISTRICTS 9 & 7-B) WILDCAT FAILURES

Baylor County: M. W. Blair 2 Mrs. Dottie Portwood, Sec. 1,280, TE&L Sur., $3^1/_2$ mi. SW Megargel, dry, TD 1,452 ft.

Brown County: R. R. Ryan 2 Nannie Keller, 161-15-A, White Sur., 3 mi. SE Burkett, dry, TD 225 ft.

J. R. Dockery & Broyles et al 1 W. W. Ezzel, SA&MG Sur. 900, 2 mi. SW Rising Star, dry, TD 2,403 ft., Caddo 2,310 ft., swabbed some oil.

Bosque County: American Liberty Oil Co. Clanton, Wm. McFarland Sur., 2 mi. SE Iredell, dry, TD 6,995 ft., Caddo 4,300 ft., Barnett shale 4,600 ft., Ellenburger 4,712 ft., Hickory sand 6,745 ft., elev. 981 ft.

Clay County: E. E. Reynolds 1 Baber, Blk. 15, Bacon Subd., 9 mi. NW Petrolia, dry, TD 1,603 ft.

Erath County: Continental Oil Co. 1 L. T. Porter, A. M. K. Hoppe Sur., A-352, $4^1/_2$ mi. S X-Ray, dry, TD 4,475 ft., Bend 3,411 ft., lower Marble Falls 3,891 ft., Barlett shale 4,070 ft., elev. 1,509 ft.

Jack County: Jack Grace Drilling Co. 1 T. H. Cherryhomes, T. Henry Sur., A-264, 2 mi. NE Cundiff, dry, TD 5,865 ft., DST 5,629-39 ft., recovered 55 ft. oil-cut mud.

Newman Bros. Drilling Co. et al 1 T. H. Cherryhomes "C," R. S. Corder Sur., A-26, 8 mi. SE Jacksboro, dry, TD 5,194 ft., show of oil 5,085-95 ft., DST recovered mud.

Jones County: R. P. Baldwin 1 L. Weeks, Sec. 20, Lot 2, A. T. Thompson Sur., $4^1/_2$ mi. N Abilene, dry, TD 1,700 ft., Dotham 1,427 ft., elev. 1,650 ft.

Lampasas County: Wm. F. Psenka 1 J. L. Buttrell, J. F. Powell Sur., 8 mi. W Lometa, dry, TD 902 ft., Marble Falls 445 ft., elev. 1,317 ft.

Shackelford County: G. E. Kadane & Sons 1 Merrick Davis "AA," NW NW NW 23-12-T&P, 6 mi. SW Albany, dry, TD 1,238 ft.

Rose & Lebus 1 C. B. Snyder, approximately NW NW SW Sec. 33, LAL Sur., 6 mi. W. Moran, dry, TD 4,249 ft., Ellenburger 4,225 ft., elev. 1,453 ft.

Taylor County: Sojourner Drilling Co. 2 H. E. Stubbs, 5-19-T&P, 3 mi. SW Merkel, dry, TD 3,553 ft., Flippen 2,510 ft., Reef 3,486 ft.

West Penn & A. E. Frazier 1 Atkinson, 81-14-T&P, 4 mi. NE Abilene, dry, TD 2,020 ft., Dotham 1,400 ft., Saddle Creek 1,695 ft., King sand 1,981 ft., elev. 1,865 ft.

Wichita County: Frank Wood 1 H. A. Mills, Blk. 7, Red River Valley Lands, 1 mi. SE Burkburnett, dry, TD 1,856 ft.

Young County: J. F. Carter 1 J. W. Casey heirs, Sec. 1,396, TE&L Sur., 9 mi. E Olney, dry, TD 850 ft., oil show 816-821 ft.

LA.-ARK.

New Pay Added in Stephens Field, Columbia County

SHREVEPORT.—Burnett Drilling Co. 1 Kate Curry, SW SW SW 5-15s-19w, added a new pay to the Stephens field of Columbia County, Arkansas, or established a new field 2 miles north, when it completed from the Travis Peak. The James limestone was faulted out, according to reports. Drilled to 4,493 ft., perforations were from 3,608-20 ft., and based on a 4-hour test, the new well's initial potential was 432 bbl. of oil a day. The gage was through $^1/_4$-in. choke, under pressures of 65 psi. on tubing and 125 psi. on casing. Gas-oil ratio was 150 cu. ft. Top of the Travis Peak was 3,598 ft., on an elevation of 281 ft.

In Union County, Dorsett Co. and R. H. Crow, Trustee 201 Union Saw Mill, 2-18s-14w, was drilling below 3,520 ft., in the Travis Peak. It is a new 4,000-ft. exploration, expected to test the Cotton Valley formation. Cores from 2,279-99 ft., in the Nacatoch, recovered 3 ft. of sand with light oil shows, and 17 ft. of sand with salt water.

Lion Oil Co. 1 Loftin, 34-18s-18w, 4 miles southwest of the Schuler field, was drilling below 7,502 ft. in the Cotton Valley, topped at 6,070 ft. It will test the Smackover.

Walter Lown 1 W. E. Baker, 22-16s-14w, was in the Travis Peak and drilling below 4,901 ft. Don D. Montgomery 1 J. K. Mahony, 25-17s-18w, was drilling below 6,627 ft. in the Cotton Valley. Formation tops had not been announced.

La Salle Parish.—H. L. Hunt Oil Co. 149-F Nebo Oil Co., SW SW 35-7n-3e, north offset to Justiss-Mears 1 Harris, was reported to have perforated in the Wilcox at 4,010-13 ft. It swabbed and flowed oil and wash water by heads, and was later credited with pumping approximately 100 bbl. of oil a day. Total depth was 4,036 ft.

Meanwhile, Justiss-Mears 1 Harris, NW NW 2-6n-3e, was pumping 89 bbl. og 39°-gravity oil a day, from perforations at 4,004-14 ft. Total depth was 5,359 ft., in the Midway section topped at 5,236 ft.

H. L. Hunt 151-F Nebo, NW NW 35-7n-3e, was drilling below 3,477 ft., in the Wilcox. Justiss-Mears 1 Mary Price, NW NW 8-6n-3e, was drilling at 820 ft.

Natchitoches Parish.—Continental Oil Co. 1 Bastrop State Bank, 18-10n-6w, was drilling below 8,225 ft., in the Travis Peak.

Tensas Parish.—Union Oil Co. of California 1 Weatherly-Anderson, SE SW 38-12n-12e, had total depth at 8,818 ft., and was running 7-in. casing. Cores at 8,793-8,808 ft. recovered fine-grained sand with gas odor. A drill-stem test from 8,793-8,808 ft., open 1 hour, recovered the 1,000-ft. water cushion, 90 ft. of mud and water, and 270 ft. of oil and sand-cut mud. Bottom-hole flowing pressure was 2,200 psi., and 3,400 psi. shut in. Cores from 8,808-18 ft. recovered shale and some siltstone.

NORTH LOUISIANA SUCCESSFUL WILDCAT

Bossier Parish: McAlester Fuel Co. A-1 Waller estate, SW SW 27-18n-13w, $2^3/_4$ miles east of Shreveport field, Bossier City townsite location, flowed 74 bbl. 43.3°-gravity oil a day, $^1/_4$-in. choke, Pettit lime 5,555-64 ft., flowing TP 450

psi., gas estimated 75,000 cu. ft. daily, TD 5,585 ft., elev.

NORTH LOUISIANA WILDCAT FAILURE

LaSalle Parish: H. L. Hunt F-148 Nebo Oil Co., NE SE 6-6n-3e, dry, TD 4,950 ft.

ARKANSAS WILDCAT FAILURE

Lafayette County: Caddo Oil Co., Inc., 1 B. E. Watthall, NE NW SE 15-16s-23w, dry, TD 2,555 ft., Tokio sand 2,524-30 ft., carried water.

ILLINOIS

Saline County Wildcat Shows for Small Well

MATTOON.—Prospects of opening a new pool in Saline County are given by showings encountered by M. E. Affeld in his 1-A Ely Gholson, NW SW NE 33-7s-7e, a rank wildcat about 4 miles northeast of the small Eldorado pool. Showings were in Tar Springs sand at 2,265-85 ft. A drill-stem test of this interval resulted in a recovery of 65 ft. of heavily oil-cut mud. Hole was drilled to 3,116 ft. in the McClosky but has been plugged back with 7-in. casing cemented on top of the Tar Springs.

North of the New Haven pool in White County, C. E. Skiles has established another new pool or an extension in his 1 McCallister, NW SW NE 7-7s-11e, which has been completed as a 60-bbl. per day pumper with production from both the Tar Springs and Cypress sands at 2,150-58 ft. and 2,480-88 ft., respectively. Cypress zone was shot with 10 qt.

An extension of the Cisne North pool in Wayne County, National Associated Petroleum Co. 1 Mable Brock heirs, NW SW NW 16-1n-7e, made a 50-bbl. pumper from McClosky lime at 3,155-60 ft. Total depth is 3,181 ft. with casing at 3,153 ft. Gray was given a 1,000-gal. acid treatment.

Producers Pipe Line Co. 1 King, NW NE SW 16-5s-4e, new pool opener in Franklin County, has been completed pumping 140 bbl. per day following a 1,000-gal. acid treatment of O'Hara lime at 3,056-62 ft.

Dunbar Drilling Co. 1 Wilson, NE NE SW 29-4s-3e, another new pool opener in Jefferson County, has been completed as a 28-bbl. pumper with casing perforated in McClosky lime at 2,940-45 ft. Pay previously was acidized with 1,000 gal.

ILLINOIS SUCCESSFUL WILDCATS

Gallatin County: C. E. Skiles 1 Abell, NW SE SW 14-8s-9e, IP 62 bbl., Cypress 2,508-15 ft., TD 2,517 ft.

Jasper County: F. Lomelino et al 1 Ochs, C NW NE 27-6n-10e, IP 53 bbl., McClosky 2,806-20 ft., St. Louis 2,902-06 ft., and 2,935-38 ft., Devonian 4,345-59 ft., and 4,394-4,402 ft., TD 4,515 ft.

Jefferson County: Dunbar Drilling Co. 1 Wilson, NE NE SW 20-4s-3e, IP 30 bbl., McClosky 2,941-45 ft. and 2,967-76 ft., TD 2,977 ft.

Marion County: The Texas Co. 1 Frank-Meyer Unit, NE SW SE 3-1n-1e, IP 214 bbl., Rosiclare 1,924-34 ft. and McClosky 1,951-80 ft., TD 2,067 ft.

Wayne County: Illinois Mid Continent Co. and Aurora Gasoline Co. 1 Richardson, NW NE SW 9-1n-5e, IP 675 bbl., McClosky 2,997-3,010 ft. and 3,024-30 ft., TD 3,092 ft.

White County: C. E. Skiles 1 McAllister, NW SW NE 7-7s-11e, IP 45 bbl., Cypress 2,475-86 ft., TD 2,486 ft.

ILLINOIS WILDCAT FAILURES

Edwards County: Pure Oil Co. 1 McKibben, SW SW SW 10-1s-10e, dry, TD 3,435 ft.

Lawrence County: Craig & Rossi 1 Wells, NE NW NE 18-2n-13w, dry, TD 3,005 ft.

Macoupin County: E. White 1 Renaker, NE NW SW 26-9n-8w, dry, TD 450 ft.

D. W. McLaughlin 1 Mindrup, SW SE NW 26-7n-6w, dry, TD 1,095 ft.

Marion County: Dietrick & Gartland 1

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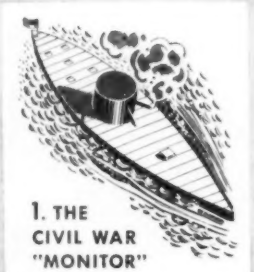

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F. D. Johnson et al 1 Bridges, SW NW NW 5-1n-1e, dry, TD 1,100 ft.

Moultrie County: A. J. Slagter, Jr., 1 Garrett, NW NW SW 8-12n-6e, dry, TD 2,039 ft.

Schuyler County: P. E. Mann 1 Rawson, NE SE NE 3-3n-4w, dry, TD 840 ft.

Shelby County: Doran et al 1 Henay Comm., SE SW NE 8-12n-6e, dry, TD 1,932 ft.

Washington County: A. J. Slagter et al 1 Moelles Comm., SW NE NE 31-2s-4w, dry, TD 3,276 ft.

OHIO, KENTUCKY

Activity Increased In Sandyville Field

COLUMBUS.—In Bethlehem Township, Stark County, a part of Sandyville field, is getting a fairly active play now for gas with wells on 160-acre spacing. The M. B. Belden Co. has a wildcat on Beitzel property in Section 28, and two field wells drilling; Ed Obermiller has four locations staked, three of which are drilling; and the Wiser Oil Co. has two field wells drilling.

Midland Oil 4 Cooperider, Section 3, Bowling Green Township, Licking County, came in as a small producer. Clinton sand at 2,977-3,022 ft. was shot with 110 qt. and made 35 bbl. in 24 hours. Across the line in Hopewell Township, Perry County, Ray Penick 1 Ralph Yost, Section 6, was shot with 80 qt. and made 36 bbl. of oil and 1,000,000 cu. ft. of gas in 24 hours. The well had been connected to the line for a year as a straight gas well.

WESTERN KENTUCKY

OWENSBORO.—Another new pool for Union County appears to have been found by Ryan Oil Co. and George & Wrather in their 1 Charles Greathouse heirs, SE cor. 24-Q-20, which recovered 210 ft. of clean oil and 30 ft. of oil-cut mud following a 2-hour drill-stem test of Cypress sand at 2,232-44 ft. Casing was cemented on top the sand, and with plug drilled, completion tests are being started.

The discovery is about 2½ miles southeast of the old Powells Lake pool and about 4 to 5 miles northeast of the Uniontown field, where some new development lately has been under way on the north and east sides. It also is just a short distance east of the Ohio River, across which in Indiana is the comparatively new Spencer pool where a number of good wells have been completed.

Location already has been made by George Engle and J. E. McCauley for an east offset, which will be their 1 Greathouse, SW cor. 23-Q-20.

WESTERN KENTUCKY SUCCESSFUL WILDCAT

Daviess County: J. C. Miller, Ashland Oil & Refining Co. and Basin Drilling Co. 1 R. L. O'Bryan, SE NE SW 13-P-28. IP 7 bbl. Tar Springs 1,234-39 ft., TD 2,002 ft.

WESTERN KENTUCKY WILDCAT FAILURE

Daviess County: Marhill Oil Co. and Basin Drilling Co. 1 Gatewood, NW SW NE 20-Q-31, dry, TD 1,350 ft.

EASTERN KENTUCKY

ASHLAND.—In Johnson County, 19-R-79, and 12 miles northwest of Paintsville, Ashland Oil & Refining Co. 8 Wallace Williams is bottomed at 5,600 ft. Crews have been attempting to straighten crooked hole before drilling ahead. Well is a Knox dolomite wildcat test and currently one of the deepest tests for this eastern portion of the state.

In western Lewis County, 4-Y-72, H. P. Purnell et al are drilling at 780 ft. on 1 C. F. Ferguson, rank wildcat which is expected to penetrate part of the Knox dol-

omite series. If it does it will be the second test of the Knox for the entire county, the other well having been drilled some years ago 15 miles southeast of the present location.

In southeastern Powell County and northeast of the old Pilot pool, Sherman Hall et al have recently completed three Corniferous producers on the E. H. Fuller farm. Wells top the Corniferous at an average depth of 1,160 ft. and are bottomed at about 1,190 ft. Initial potentials range from 8 to 30 bbl. per day.

EASTERN KENTUCKY WILDCAT FAILURE

Breathitt County: Diederich & Ware 1 Boone Coal & Timber Co., 1-N-75, dry, TD 2,348 ft.; Big Lime 1,077 ft., Berea sand 1,667 ft., Corniferous 2,031 ft., Big Six sand 2,250 ft.; no shows.

INDIANA

EVANSVILLE.—Testing is under way in Winmar Oil Co. 1 White, SW NE SW 29-1s-10w, prospective new pool opener in Gibson County. After swabbing at the rate of 51 bbl. of oil and 3 bbl. of water per day, it is being put on the pump. Production is from Cypress sand at 1,673-90 ft., with casing at 1,670 ft. It is 1½ miles southeast of production in the Patoka East pool and about 3 miles northeast of the town of Princeton.

After recovering 30 ft. of clean oil and 60 ft. of oil-cut mud in a drill-stem test of the Devonian, which showed saturation at 1,856-60 ft. and 1,868-73 ft., Gilliam Drilling Co. and Warren Usrey have run casing in their 1 Huntwork, NW NW SE 20-10n-8w, a rank wildcat southwest of the town of Blackhawk in southeastern Vigo County. The test took in an interval at 1,850-75 ft., embracing the two saturated zones. Total depth is 1,984 ft. with casing at 1,977 ft.

INDIANA WILDCAT FAILURES

Daviess County: E. Zink 1 Beasley, NE NW SW 2-4n-5w, dry, TD 1,085 ft.

Gibson County: V. R. Gallagher 1 Mumford, NE SE NW 29-3s-13w, dry, TD 2,891 ft.

Spencer County: W. W. Dameron 1 Loren Dauffer, SW SW SW 2-7s-6w, dry, TD 932 ft.

SOUTH LOUISIANA

Continental Testing Well Close to Welsh Dome

NEW ORLEANS.—Continental Oil Co. has started testing its 1 R. A. Estes, wildcat approximately 1½ miles northeast of Welsh dome, Jefferson Parish, 11-9s-5w. Hole is bottomed at 11,474 ft., with 4-in. string cemented at this point, and operators are now testing through perforations at 11,374-87 ft.

Kerr-McGee Oil Industries, Inc., has completed its Block 28 wildcat off Terrebonne Parish as a gasser. The well was drilled to 14,451 ft., one of the deepest in the area, and perforations for production were made at 8,482-90 ft.; no gage as yet. In the first hole drilled, a good gas-condensate sand was cored at 14,000 ft., and operators drilled ahead to penetrate the salt before testing. However, a hurricane, which occurred last September, disrupted operations and the hole was never regained. The well is now shut in.

Magnolia Petroleum Co. is still testing deep sands off the northwest flank of the Iowa Dome, in Calcasieu Parish, in its 1 Bowan Estate, 12-9s-7w. On initial test, the well flowed 67 bbl. of oil per day through 12 64-in. choke through perforations at 10,202-07 ft., with flowing pressure on tubing at 3,000 psi. Operators are still testing the hole for completion.

Magnolia Petroleum Co. is completing its third gas well in the Gulf of Mexico, A-1 State Lease, Block 110, approximately 27 miles from Iberia Parish shoreline and directly south of East Cote Blanche Bay. Al-

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though no completed gage has been made, the flow is estimated at 7,040 Mc.f. gas per day through ¼-in. choke with a spray of distillate. Operators struck the sale dome at 12,067 ft., and finally completed at nearly 10,000 ft.

PERMIAN BASIN

Completion Potential Taken On Ellenburger Discovery

MIDLAND.—Completion potential was taken on Superior Oil Co. 1 J. R. Dockery, 17-28-T1S-T&P, Ellenburger discovery 3 miles southwest of Westbrook in Mitchell County, which gave the county its first well in that formation. Location was said to be in the same area in which Underwriters Production Co., now Standard Oil Co. of Texas, 1 Abrams brought in the first production for West Texas, in October 1920.

The 1 Dockery flowed 172 bbl. of 45.3°-gravity oil a day, plus 60 bbl. of salty sulfur water, through 11/64-in. choke, from bottom of casing at 7,990 ft. to 8,004 ft., total depth. Top of the formation was 7,984 ft. Gas-oil ratio was 335 cu. ft. Tubing pressure was around 300 psi. The official gage was considerably under previous estimates from unofficial reports.

On the north side of the North Snyder field, two locations marking ¼-mile extensions were: Standard Oil Co. of Texas 2 J. W. Brown, SW SE 449-97-H&TC, on which drilling was well under way, and Standard of Texas 3 J. W. Brown, SW SE 450-97-H&TC. Other locations were made in Sections 439, 440, and 441.

In Section 450, Block 97, Standard of Texas completed its 3-8 J. W. Brown for 1,362 bbl. of oil a day, flowing through ½-in. choke from open hole at 6,616-6,832 ft., total depth.

A new wildcat located 11 miles east of Snyder is to be drilled by C. L. Norsworthy, Jr., as the 1 Grady Williams, NE NE 63-3-H&TC. Contract depth is 7,500 ft., to explore the Ellenburger.

In the Sharon Ridge Canyon field, Humble Oil & Refining Co. 1 Wright Huddleston, 163-97-H&TC, extended production ½ mile to the west with a completion potential of 246 bbl. of 43°-gravity oil a day, flowing through 10/64-in. choke from open hole at 6,585-6,685 ft.

Schleicher County.—Southern Minerals Corp. 1 Webster, wildcat test 25 miles east of the town of Eldorado in NW SW 2-8-TW&NG, reported additional shows of gas in drilling ahead to 4,530 ft. At last report, a 3-hour drill-stem test with packer at 4,500 ft. recovered 30 ft. of gas-cut drilling mud, plus free gas in the drill pipe. An earlier test in the top of the Strawn from 4,336-74 ft. produced a strong blow of air throughout the 45-minute period, and recovered pipe full of gas and 100 ft. of oil and gas-cut drilling mud. On an elevation of 2,616 ft., the well entered the Strawn at 4,327 ft., which was said to be 205 ft. low to the same formation top at Phillips Petroleum Co. 1 Callanan., 6,065-ft. dry hole located 7 miles northeast of 1 Webster, but 230 ft. high on the Strawn to an Ellenburger failure 8 miles to the southwest, drilled in 1938 as Textor 1 Judkins & Spencer.

Upton County.—Humble Oil & Refining Co. 1 Pembrook, wildcat test 6 miles north of the Benedum field, was waiting on cement after setting 7⅝-in. casing on bottom at 10,690 ft. Operators were to drill plug and deepen. Location is 660 ft. from north and 2,247 ft. from east lines, Block X, C. C. DeWitt Survey.

Coke County.—Humble 2 Odom, Felix Sosa Survey, 2¾ miles northwest of the same company's 1 Odom, Strawn discovery in northwest Runnels County, found water in the Palo Pinto section of the Pennsylvanian. A 1-hour drill-stem test at 4,040-4,100 ft. recovered 500 ft. of salt water and 40 ft. of drilling mud, with no shows.

Midland County.—York & Harper, Inc., was rigging up rotary at its 1-A TXL, which skidded the rig 30 ft. south after drilling to 4,445 ft. in the original hole. Proposed depth is 13,800 ft. New location is 30 ft. south of NE SW 25-29-T3S-TP Survey, and about 12 miles south of the city of Midland.

Andrews County.—George P. Livermore, Inc., and Deep Rock Oil Corp. 1 Mayhew, NW SE 20-A51-PSL, 6 miles north of the Dollarhide field, topped the Devonian lime at 9,630 ft. on an elevation of 3,279 ft. It was drilled to 9,670 ft. and preparations made to drill-stem test.

WEST TEXAS (DISTRICTS 8 & 7-C) WILDCAT FAILURES

Culberson County: Mills-Lee 5 J. H. Fisher, 12-110-PSL, 22 mi. SW Orla, dry, TD 938 ft. in sand, shot 870-900 ft., bailed 10-15 gal. oil a day.

Russell & Wadsworth 1 J. H. Fisher, W½ SW SW 7-111-PSL, 23 mi. W Orla, dry, TD 890 ft.

R. H. and A. L. Smithpeter 1 W. A. Scott, NW NW NW 22-114-PSL, 27 mi. W Orla, dry, TD 1,844 ft. in sand.

SOUTHEASTERN NEW MEXICO

HOBBS.—Amerada Petroleum Corp. 1-BTB State, NW NW 26-12s-33e, had flowing oil from the Devonian on several drill-stem tests. The well was said to be running some 470 ft. high, on the Mississippian, with Amerada's 1-BTA State in 2-12s-33e. Tentative top by operators on the Devonian in the 1-BTB was 10,095 ft., on an elevation of 4,259 ft. With total depth at 10,261 ft., a 5-hour drill-stem test was run from 10,090-150 ft., using 1,000 ft. of water blanket. Gas surfaced in 56 minutes, followed by the water blanket 1 minute later, and oil in 62 minutes. For the balance of the test it flowed at the rate of 46 bbl. of 59°-gravity oil an hour. Flowing pressure ranged from 1,100-4,000 psi. A 3-hour test from 10,150-200 ft. had gas and water blanket in 25 minutes and oil in 30 minutes, and

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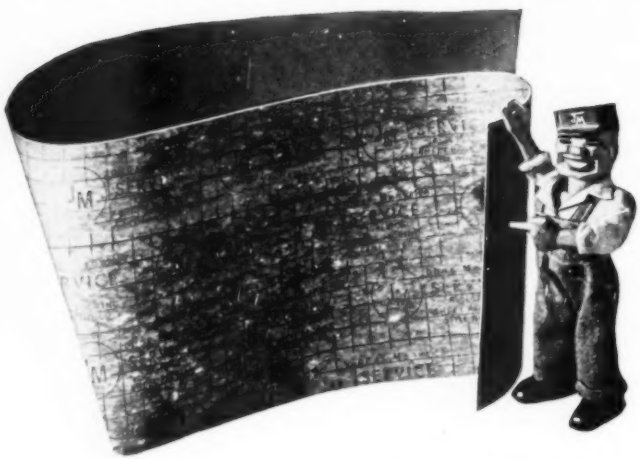

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frowed 222 bbl. of 57.7°-gravity oil in 2½ hours. Gas was estimated at 884,000 cu. ft. daily. When the drill pipe was pulled it unloaded some 480 ft. of salt water. A second 3-hour test from 10,199-250 ft., with no water blanket, produced a light blow of air and recovered 360 ft. of drilling mud cut with salt water, plus some 8,000 ft. of salt water.

Amerada 1-BTA, NW SE 2-12s-33e, was waiting on storage tanks for completion tests, in what is reported as the Devonian-Silurian. Total depth was 11,766 ft., plugged back to 10,990 ft. A drill-stem test of perforations at 11,000-030 ft. recovered 4,000 ft. of oil and 640 ft. of salt water. Perforations were then squeezed and new shots placed at 10,950-65 ft., which yielded 81 bbl. of oil in 16 hours, cut 2 per cent with sediment. Recovery was 9,690 ft. of oil and 900 ft. of oil and gas-cut water, plus some water with salty taste. Operators acidized with 250 gal. at 10,950-965 ft., after which the well flowed 400 bbl. of oil, with no water in 5½ hours, through ½-in. choke.

McAlester Fuel Oil Co. 1 J. M. Denton, 11-15s-37e, was drilling ahead below 10,296 ft. after drill-stem testing from 10,190-285 ft. With the tool open 30 minutes, recovery was 450 ft. of gas-cut mud. A core at 10,285-296 ft. recovered 10 ft. of lime with light staining and porosity.

Amerada's 1 Stella Bennett Rose, north offset to its 1 Hamilton discovery, was drilling below 10,750 ft.

A pre-Cambrian test for central Chaves County was reported as the Buffalo Oil Co. 3 Comanche unit, located in the SW NW 26-11s-36e, in the Bottomless Lakes region, 12 miles southeast of Roswell. Projected depth was 6,600 ft.

CANADIAN FIELDS

Not Enough Gas Reserves For Alberta Pipe Lines

CALGARY.—No applications for gas pipe lines out of Alberta will be given favorable consideration at present because the government is not satisfied there are sufficient reserves under sound conservation and proration practices to meet the present and future needs of the people of the Province, according to an official statement of Premier Manning.

The Western Canada Petroleum Association informed its members that it interprets the Premier's statement as favorable for the long term, and committing the government to the policy of gas exports when sufficient reserves have been developed.

The Dinning Commission, set up to study the natural gas reserves of Alberta and possibilities of natural gas exports, reported to the provincial government that in 1948 the existing proven reserves were in excess of 4 trillion cubic feet, sufficient to supply present demand for approximately 70 years, and even with an increase in demand of 61 per cent, a reserve supply for Alberta's needs of 50 years.

WILDCAT FAILURES IN CANADA

Donatville, Bear Hollywood 1, LSD 4, 1-67-21w4th, TD 2,880 ft.

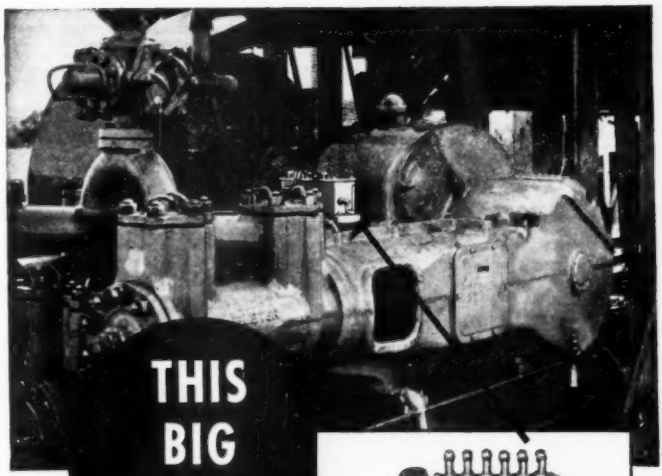
Pacific Western Evansburg 1, LSD 13, 31-54-7w5th, TD 7,220 ft.

Stettler, Picadilly Interlude Edwards 3, LSD 2, 22-38-21w4th, TD 4,573 ft.

Thorhild, Redwater Consolidated 3, LSD 16, 21-60-22w4th, TD 3,720 ft.

EASTERN CANADA

HURON.—In Huron County, Ontario, a Clinton syndicate is bringing in a rotary outfit for a test on the Bert Allen farm, Concession 13, Hullett Township, 12 miles northeast of Clinton. Location is 60 rods from an inconclusive test drilled about 10 years ago to 1,601 ft. which encountered oil indications in a limestone formation. Operations at that time were discontinued because of the war.



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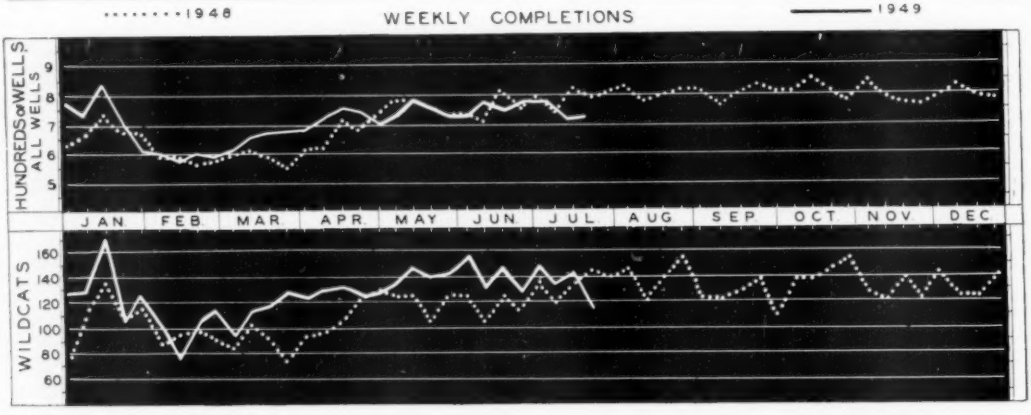
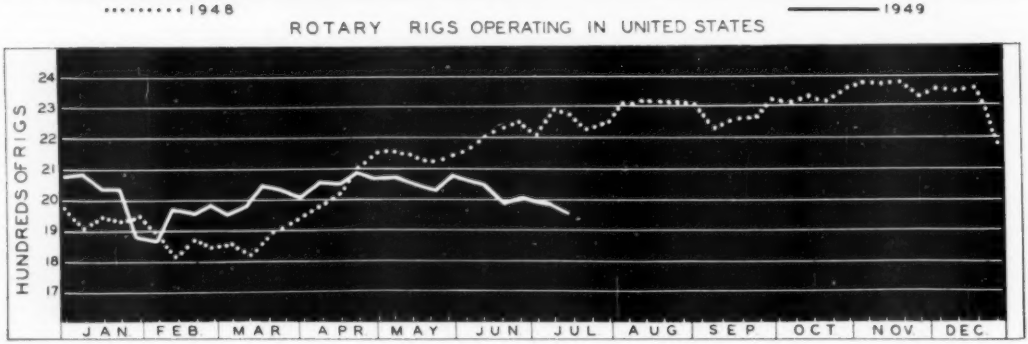
WEEKLY WELL COMPLETIONS . . . . WEEK ENDED JULY 23, 1949

	Total of all wells					29 wk.		Wildcat completions and discoveries					Cumulative total, 1949				
	Comp.	Oil	Gas	Dry	Footage	1949	1948	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	12	6	0	*6	13,544	596	837	0	0	0	0	0	0	0	0	0	0
Pennsylvania	20	7	4	†9	40,398	865	1,434	0	0	2	0	2	0	0	3	1	4
West Virginia	9	1	7	1	25,701	265	440	0	0	0	0	0	1	0	6	6	13
Ohio	16	8	4	4	28,060	576	716	0	0	0	0	0	1	0	2	21	24
Indiana	28	8	0	20	47,134	685	559	0	0	0	3	3	12	0	0	132	144
Kentucky	22	9	2	‡11	35,205	479	369	1	0	0	2	3	12	0	0	37	49
Illinois	54	31	1	22	129,281	1,324	1,204	6	0	0	10	16	33	0	1	216	250
Michigan	20	9	1	10	46,591	524	401	0	0	0	5	5	19	0	1	165	185
Kansas	74	27	19	28	238,206	1,703	1,652	1	0	0	7	8	35	0	4	215	254
Neb., Mo., Iowa	1	1	0	0	4,429	14	2	1	0	0	0	1	1	0	0	9	10
Oklahoma	69	40	2	27	236,500	2,315	2,176	1	0	0	12	13	84	9	10	338	441
Texas	289	186	11	92	1,078,903	7,390	6,235	5	2	1	40	48	221	32	66	1,274	1,593
N. Central (Dist. 7-B & 9)	111	70	0	41	246,076	2,427	1,914	3	0	0	16	19	96	0	10	499	605
West (Dist. 7-C & 8)	64	51	0	13	272,289	1,760	1,710	0	0	0	3	3	30	0	3	148	181
Panhandle (Dist. 10)	23	18	4	1	69,414	600	319	0	0	0	0	0	1	0	0	3	4
Eastern (Dist. 5, 6 & 6-P)	13	5	1	7	68,901	370	283	0	0	0	5	5	5	2	3	79	89
Gulf Coast (Dist. 2 & 3)	42	23	1	18	239,624	1,100	1,006	1	2	0	9	12	49	24	30	218	321
Southwest (Dist. 1 & 4)	36	19	5	12	182,599	1,133	1,003	1	0	1	7	9	40	6	20	327	393
Louisiana	42	28	1	13	204,506	1,152	1,180	1	0	0	1	2	33	10	3	113	159
Northern	29	21	1	7	90,239	631	785	1	0	0	1	2	2	2	0	48	52
Southern	13	7	0	6	114,267	521	395	0	0	0	0	0	31	8	3	65	107
Arkansas	9	7	0	2	33,170	169	156	0	0	0	1	1	3	0	0	32	35
Mississippi	3	0	0	3	22,025	194	215	0	0	0	3	3	4	0	1	58	63
Southeastern States	1	0	0	1	8,100	26	27	0	0	0	1	1	1	0	0	23	24
Montana	2	0	2	0	12,174	128	136	0	0	1	0	1	2	0	2	18	22
Wyoming	9	4	0	5	33,441	328	257	0	0	0	1	1	16	0	0	57	73
Colorado-Utah	3	2	0	1	14,726	70	132	0	0	0	0	0	1	0	0	28	29
New Mexico	5	5	0	0	26,996	293	334	0	0	0	0	0	7	0	0	30	37
California	41	34	1	6	204,353	1,492	1,563	0	0	1	5	6	26	0	6	249	281
Total United States	729	413	55	261	2,483,443	20,588	20,025	16	2	5	91	114	512	51	105	3,022	3,690
Total previous week	703	368	58	277	2,377,061	19,859	19,234	20	0	2	120	142	496	49	100	2,931	3,576
Total July 24, 1948	791	436	60	295	2,658,362			24	3	7	110	144	459	41	149	2,632	3,281

Service wells included: *6, †9, ‡1.





DAILY AVERAGE PRODUCTION FOR WEEK

	July 23 crude oil	B. of M. July demand	July 16 crude oil
Alabama	1,200	1,350	1,200
Arkansas	72,650	87,000	72,600
California	908,100	928,000	911,900
Colorado	65,000	65,000	65,200
Eastern	62,000	60,850	61,000
Florida	1,400	1,400	1,375
Illinois	176,200	170,000	178,900
Indiana	29,700	24,000	26,300
Kansas	258,600	302,000	228,700
Kentucky	23,200	21,000	23,500
Louisiana	473,950	510,000	473,950
North Louisiana	105,900		105,900
South Louisiana	368,050		368,050
Michigan	38,500	46,000	38,100
Mississippi	97,650	109,000	96,700
Montana	27,800	24,000	27,500
Nebraska	600	700	600
New Mexico	136,300	131,000	136,300
Oklahoma	377,350	410,000	377,550
Texas	1,805,000	2,150,000	1,805,000
Dist. 1 (Southwest)	25,570		25,570
Dist. 2 (Southwest)	108,825		108,825
Dist. 4 (Southwest)	174,675		174,675
Dist. 3 (Gulf Coast)	334,905		334,905
Dist. 5 (Eastern)	32,150		32,150
Dist. 6 (Eastern)	78,700		78,700
East Texas Field	221,000		221,000
Dist. 7-C (West)	41,425		41,425
Dist. 8 (West)	499,375		499,375
Dist. 7-B (W. Central)	57,400		57,400
Dist. 9 (N. Central)	137,175		137,175
Dist. 10 (Panhandle)	93,800		93,800
Utah	1,000	700	950
Wyoming	129,500	118,000	126,600
Total United States	*4,685,700	5,160,000	4,653,925
Change from prev. week, up	31,775		
Canada	57,415		58,515

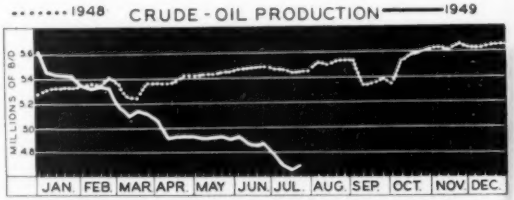
Total U. S. production January 1-July 23 †1,047,637,315 bbl.
Same period last year (crude plus cond.) 1,120,713,465 bbl.

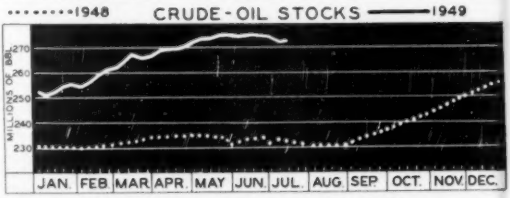
*Not including 78,730 bbl. condensate †Including 16,981,380 bbl. condensate.

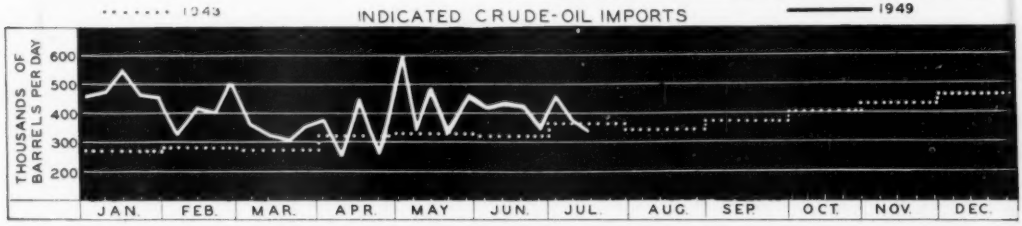
CRUDE STOCKS BY STATES OF ORIGIN

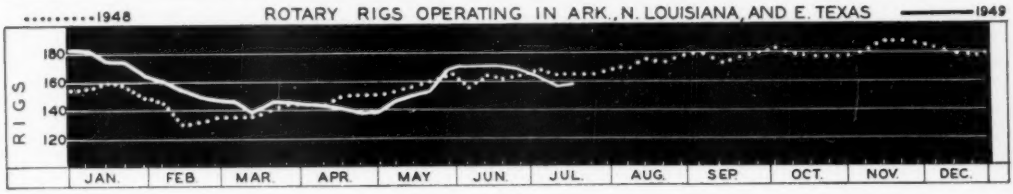
(Thousands of barrels)

—State of origin—	July 16, 1949	July 9, 1949	July 17, 1948
Pennsylvania Grade	3,032	3,009	2,735
Other Appalachian	2,121	2,251	996
Ill., Ind., Mich.	14,913	14,443	11,291
Arkansas	3,006	2,953	2,589
Louisiana	15,460	14,587	11,344
North	3,611	3,432	3,272
Gulf	11,849	11,155	8,072
Mississippi	3,157	2,917	2,686
New Mexico	7,703	7,576	5,662
Oklahoma and Kansas	39,209	39,174	34,569
Texas	127,060	128,352	111,612
East Texas	16,844	17,714	15,843
West Texas	51,529	51,746	42,532
Texas Gulf	29,861	30,046	29,113
Other Texas	28,826	28,846	24,124
Rocky Mountain	14,126	13,955	9,357
California	35,204	34,896	30,094
Foreign	7,155	7,807	5,471
Total United States	272,148	271,920	228,406









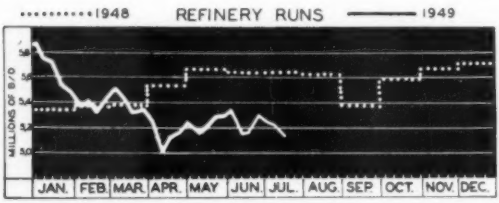
Refining Statistics

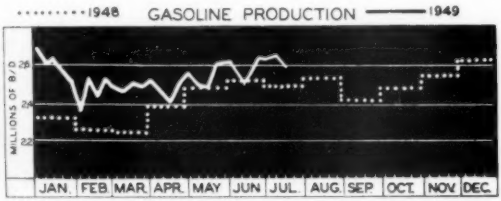
A.P.I. REFINERY REPORT, JULY 16

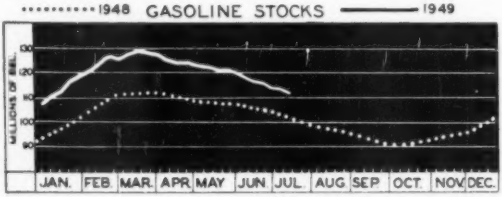
(Thousands of barrels)

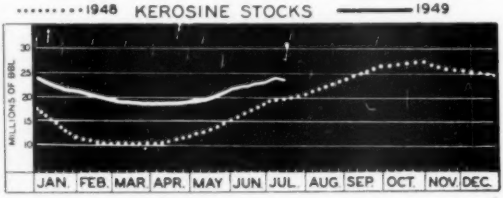
District—	Daily avg. crude runs	Daily average production				Stocks at refineries, bulk terminals, in transit and in pipe lines				Bureau of Mines, July 1948				
		Gasoline*	Kerosine	Distillate	Residual	Gasoline†	Kerosine	Distillate	Residual	Daily avg. crude runs	Daily average production			
											Gasoline*	Kerosine	Distillate	Residual
East Coast	740	305.0	16.7	144.1	158.9	25,666	9,827	22,333	10,131	891	320.7	43.5	170.6	222.6
Appalachian:														
District 1	76	36.1	1.7	8.9	9.0	2,431	436	681	498	93	40.0	4.8	12.1	11.1
District 2	60	34.1	1.4	5.4	12.1	1,094	161	192	331	36	15.5	1.1	4.6	10.0
Ind., Ill., Ky.	881	486.1	45.2	125.6	134.6	24,036	4,310	10,771	5,469	932	491.5	52.0	128.0	154.7
Okla., Kans., Mo.	428	237.6	17.4	83.3	60.7	10,845	1,509	5,299	2,440	483	246.2	22.8	87.0	79.0
Inland Texas	231	146.6	13.4	16.9	55.4	3,978	633	840	1,296	248	144.8	8.2	31.0	60.2
Texas Gulf Coast	1,214	649.0	69.7	189.1	225.0	16,006	2,952	10,402	7,895	1,395	601.5	102.8	295.2	259.9
La. Gulf Coast	375	187.3	39.4	63.8	39.7	5,180	2,398	4,605	2,151	435	185.5	45.1	92.7	77.9
N. La. and Ark.	81	29.7	5.6	10.8	15.4	2,688	461	1,005	275	84	30.5	7.5	12.2	19.5
Rocky Mountain:														
New Mexico	9	4.9		1.3	2.3	55	25	88	32	12	6.0	0.4	1.7	3.6
Other Rocky Mtn.	171	71.1	7.0	26.6	32.4	2,960	337	1,488	777	151	61.3	3.9	24.0	28.9
California	864	400.6	1.2	138.3	366.6	16,525	742	10,918	36,269	871	351.4	12.5	135.1	336.4
July 16, 1949‡	5,130	2,588.1	218.7	814.1	1,112.1	111,464	23,791	68,622	67,564	5,631	2,494.9	304.6	994.2	1,263.8
July 9, 1949	5,201	2,651.3	226.6	824.0	1,125.6	113,763	24,055	66,620	67,136					

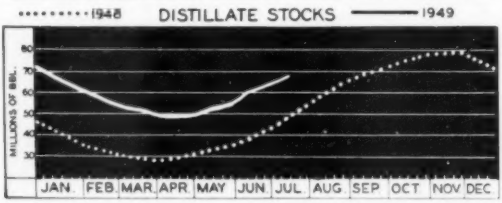
*At refineries including natural blended. †Finished and unfinished. ‡Comparable data for 1948 on new basis not available.

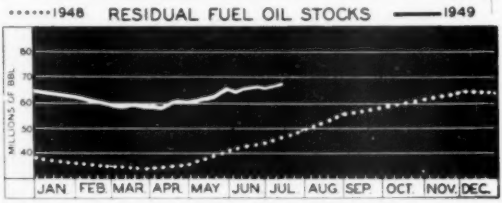


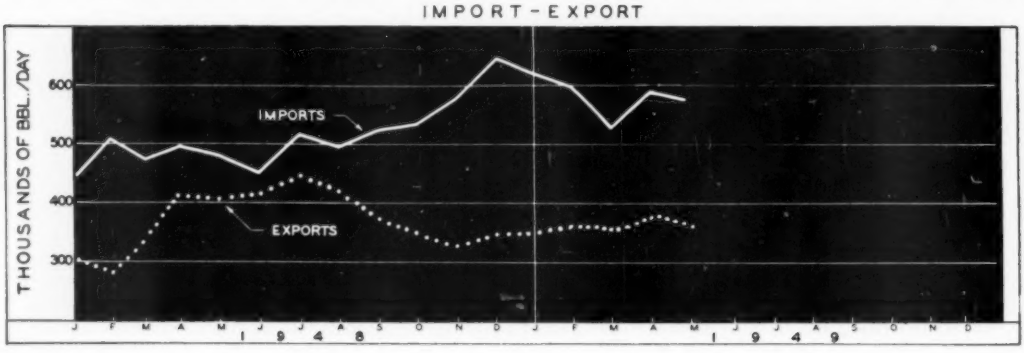












CRUDE PRICES GRAVITY SCHEDULE

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex *	West Tex.†
18-18.9	$1.78			
19-19.9	1.85			
20-20.9	1.93	$2.25		$2.12
21-21.9	2.00	2.27		2.14
22-22.9	2.07	2.29		2.16
23-23.9	2.13	2.31		2.18
24-24.9	2.20	2.33	$2.56	2.20
25-25.9	2.26	2.35	2.58	2.22
26-26.9	2.31	2.37	2.60	2.24
27-27.9	2.37	2.39	2.62	2.26
28-28.9	2.42	2.41	2.64	2.28
29-29.9	2.48	2.43	2.66	2.30
30-30.9	2.54	2.45	2.68	2.32
31-31.9	2.59	2.47	2.70	2.34
32-32.9	2.64	2.49	2.72	2.36
33-33.9		2.51	2.74	2.38
34-34.9		2.53	2.76	2.40
35-35.9		2.55	2.78	2.42
36-36.9	*	2.57	2.80	2.44
37-37.9		2.59	2.82	2.46
38-38.9		2.61	2.84	2.48
39-39.9		2.63	2.86	2.50
40 and above		2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico. Last general price change represented a 50-cent increase becoming effective December 6, 1947. Above changes do not include recent reductions of a few buyers applying principally to low-gravity grades.

FLAT CRUDE PRICES

Representative posted schedules per barrel	
East Texas†	$2.65
Kettleman Hills, California*	2.77
Beauregard Parish	2.60
Illinois Basin	2.77
Pecos County, Texas (Yates)	2.35
Bradford, Pennsylvania	3.40
Eastern Ill. and Western Ind.†	2.77
Tomball, Texas Gulf Coast	2.83

*37°-37.9°. †35° and above

THE current rate of distillate movement from refineries indicates that summer fillup discounts to consumers and resellers have had little effect on primary sales. Sales for storage are still far below normal.

In the Mid-Continent area suppliers report an increase in inquiries about distillate fuel but very little improvement in actual sales. Diesel demand continues good and accounts for a large part of the spot movement.

On the East Coast distributors have been able to make a few deliveries to home-heating tanks but only after very active selling programs. Most of the summer discounts were period price cuts for July and August but it is reported that some distributors have extended the consumer discount period through September.

Heavy reductions in gasoline stocks plus a contraseasonal drop in kerosine inventories for the week ended July 16 offset gains by distillate and residual for a net reduction of 132,000 bbl. in major product stocks. This net decrease, combined with the overall drop of 278,000 bbl. for the week of July 2, counteracts the record increase of 3,628,000 bbl. during the week ended July 9 and gives a more normal gain for the period.

Colder-than-normal weather in the northeastern part of the country could produce a kerosine shortage this winter. Kerosine stocks are less than 5,000,000 bbl. above last year. Refinery runs east of California are about 11 per cent below last year but kerosine production is down more than 25 per cent. If runs and kerosine yields remain low, stocks at the end of this quarter may be below last year's level.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of July 25, 1949. Figures are f.o.b. plant for tank-car shipment in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Tex. Gulf Coast
Regular gasoline, 73-75 octane	9⅝-10	11-11.5	9½-10
Premium gasoline, 78-80 octane	10⅜-11	12-12.5	10½-11
42-44 w.w. kerosine	7¾-8¼	7.5-8.4	7.50-8
No. 2 straw fuel oil	6⅜-6⅞	6.5-7.4	6⅜-6½
No. 6 residual	$0.85-0.90	$1.60	$1.25-1.35

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5½	5	5¼
Grade 18-55	6.6	6	6.3

LUBRICATING OILS
South Texas

200 vis., No. 2-3 neutral	11
750 vis., No. 3-4 neutral	14
2,000 No. 5-6 neutral	16-16.5

LUBRICATING OILS
Mid-Continent

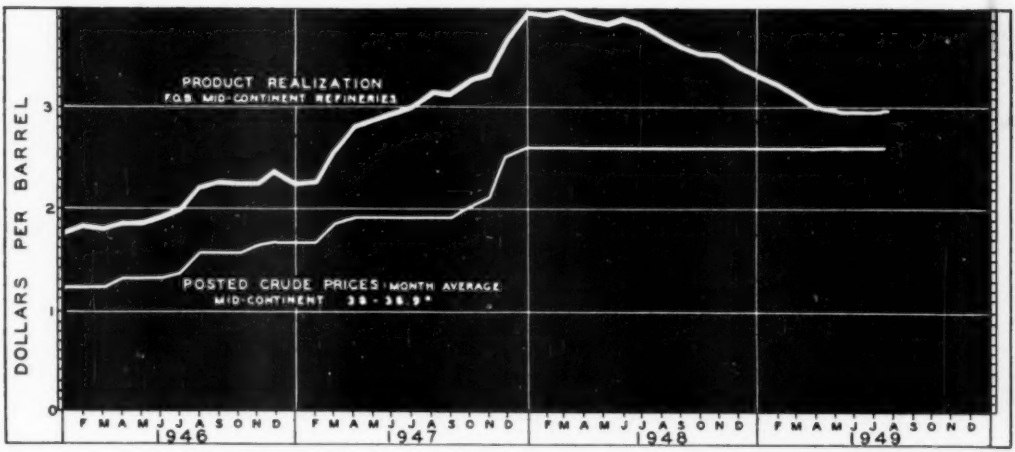
150-160 vis., D bright stock, 0-10 pp.	19
200 vis., No. 3 neutral, 0-10 pp.	12-14

Western Pennsylvania

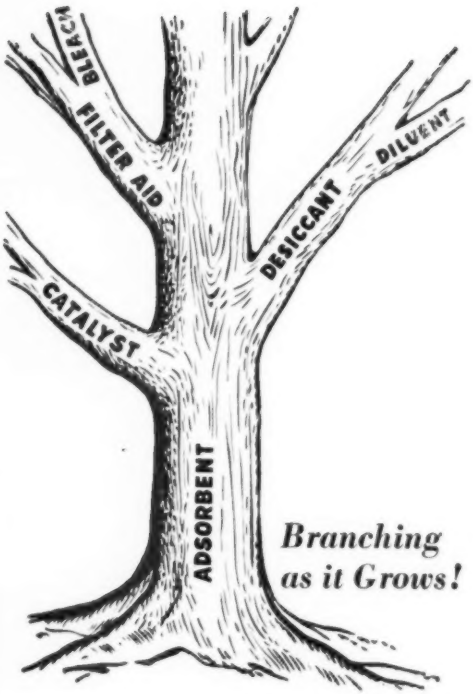
144-155 vis., 10 p.t. bright stock	19.5
180 vis., 0 p.t. neutral	20.5

CRUDE-SCALE WAX
Mid-Continent

132-134 A.M.P.	4.5



In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil



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EQUIPMENT MEN . . . in the News

Eastman Announces Several Changes on Sales Staff

HERM SCHALLER

Several recent personnel transfers and promotions have been announced by Eastman Oil Well Survey Co.

Herm Schaller has been named division sales manager of the Rocky Mountain-Mid-Continent division of the company, with headquarters in Denver. Schaller, formerly sales representative in Long Beach, has been with the Eastman organization for 2 years.

F. W. SQUYRES

J. C. STATON

Heading Eastman's new office in New Orleans is Frank Wilbur Squyres, district sales manager. Squyres before the war was a field engineer for Eastman, and before returning to work for Eastman, was affiliated with Gulf International Corp.

Another important position, that of Gulf Coast field superintendent, has been filled by J. C. Staton, whose headquarters will be in Houston. Staton has had 8 years' service with Eastman, and has served as field engineer for the Lafayette and Corpus Christi offices during his career with the company.

New district sales manager for Oklahoma is Robert W. Sneed, of the company's Oklahoma City office. Sneed started with the company as a sales and service engineer 2 years ago.

Additional changes in the sales department of the organization include the transfer of David P. Neill to Odessa from Victoria, Tex. Replacing Neill at Victoria is Pete T. Bush, sales and service engineer, who has been with the Eastman company for a year.

New sales representatives at Longview, Tex., is Michael A. O'Bannon, formerly a service engineer for Mud Control Laboratories in Oklahoma City and for Baroid Sales Division in Tulsa. Lee Fields is new sales representative at Houston, and sales and service engineer at Alice, Tex., is Claude A. Collins.

H. K. Porter Acquires Jarecki Manufacturing Co.

H. K. Porter Co., Inc., of Pittsburgh, has completed its acquisition of Jarecki Manufacturing Co., of Erie, Pa., T. M. Evans, president of Porter, has announced.

Jarecki, founded in 1852, manufactures a broad line of valves and fittings, and operates 27 stores in Mid-Continent oil fields. Evans said that the expansion was in accordance with the Porter company's policy of acquiring companies with well-established products. He said that Jarecki valves and fittings would be a logical addition to the Porter's present products which include oil-field equipment, valves, pumps, springs, chemical-processing equipment, and locomotives.

Simmons and Lundie Get Johnston Pump Promotions

T. W. SIMMONS, JR.

K. G. LUNDIE

Important changes in personnel have recently been announced by Johnston Pump Co., Los Angeles, T. W. Simmons, Jr., has been elected vice president and general manager of the company, and Kenneth G. Lundie has been appointed general sales manager.

Simmons until recently was president of Johnston Aquamatic Co., of York, Pa. He has been identified for many years with the petroleum in-industry in California. Lundie has been connected with sales in the turbine-pump business for over 25 years. He formerly was western sales manager for Pomona Pump Co., and was in charge of sales for C. J. Hammer Co., of Visalia, Calif.

Leland Dresser Organizes Cooling-Tower Repair Firm

LELAND DRESSER

Leland "Lee" Dresser, formerly superintendent with Fluor Corp., has organized his own cooling-tower repair company to negotiate contract work with the oil industry in the rebuilding, repairing, and remodeling of all types and makes of cooling towers. The new organization is known as Dresser Cooling Tower Co., and its headquarters are located at 4923 Firestone Boulevard, South Gate, Calif.

Dresser has had 20 years of extensive experience in this field and he will be assisted by his younger brother, Lawrence Dresser, as field superintendent. O. L. Michaels is company manager. Most of the carefully picked field crew have worked under Dresser's supervision previously.

J. B. Beaird Adds Ching And Mogle to Sales Staff

Two new additions to the sales force of J. B. Beaird Co., Shreveport, have been announced recently by John L. Tullis, manager of sales.

Robert Ching of New Orleans has been appointed sales representative in the New Orleans, Baton Rouge, Lake Charles area, and Homer B. Mogle has been assigned as representative in the Kansas and Nebraska area.

Ching was formerly with A. O. Smith Co., and Mogle has been associated with the liquefied petroleum gas and gasoline industry for a number of years.

Link-Belt Appoints New Rocky Mountain Distributor

Link-Belt Co. has announced the appointment of Bettis Corp., Casper, Wyo., a stock-carrying distributor of Link-Belt vibrating mud screens and replacement parts.

Bettis Corp. is well acquainted with the Link-Belt shale shaker, inasmuch as its Houston headquarters has been handling the distribution of replacement parts for these shakers in Mid-Continent and Gulf Coast areas for the past 19 years.

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All ads, 12 cents a word. Minimum charge, $3.00 per insertion.
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THE OIL AND GAS JOURNAL
P. O. Box 1260, TULSA, OKLAHOMA

EQUIPMENT FOR SALE

1—Link Belt Company Portable screw conveyor unit with one 9" Dia. by 13 ft. long screw feeder and one 4½" Dia. by 8 ft. long screw feeder. Good condition. Ideal for mud mixing. Mr. Carruth, Sunray Oil Corporation, Philtower Building, Tulsa 3, Oklahoma.

FOR SALE: Practically new 70 B Brewster Drawworks equipped with G. M. Diesel 6 Motor & transmission, all friction clutches—automatic cathead. This drawworks has drilled 35,000 feet in shallow wells—oeing replaced by larger unit. Price $10,000.00 f.o.b. Salem, Illinois. Herman Graham Drilling Co., Box 176, Salem, Illinois. Phone 580.

EQUIPMENT FOR SALE

FOR SALE: Model "K" Cardwell, single drum draw works powered by G.A.K. Waukesha engine. Equipped with 98' "A" mast and sub skid. Priced for quick sale. Terms. Melton Supply Co., Seminole, Okla.

SAVE WITH SAFETY—Very Good Used Wire Line—Any Size or Length up to 5,000' —Respooled for Your Inspection — Cable Tools for Sale. General Tool & Supply Co., P.O. Box 4387, Phone 61335, Oklahoma City, Okla.

HOT OIL PUMPS AND COMPRESSOR

1—Worthington horizontal duplex reciprocating pump, enclosed frame, outside end packed plungers, forged steel fluid end, water cooled stuffing boxes, stainless steel valves and seats, size 10x3x10. 1—Clark engine and compressor, engine 80 H.P., size 16" x 15" x 7¼" x 20", 200 R.P.M., compressor intake pressure 0 lbs. discharge pressure 350 lbs., type Q compressor cylinders. 1—Worthington 4" x 18", 4-6 chrome block, horizontal, duplex, double plunger, enclosed frame hot oil fitted power pump, driven by Worthington 12½" x 14" horizontal, double acting steam engine with some spare parts for engine. 1—Worthington 5¼" x 18", 4-6 chrome block, horizontal, duplex, double plunger, enclosed frame, hot oil fitted power pump with some spare parts, driven by Worthington 12½" x 14" horizontal, double acting steam engine with some spare parts. Equipment second hand, in good condition; spare parts new. American Liberty Oil Company, Mt. Pleasant, Texas.

FOR SALE: Failing "1500" portable rig for shot-hole, core, water-well, and shallow production drilling. Equipped with sand reel and bailer. Mounted on GMC truck. Rig and Truck in excellent condition. Rider & Montgomery, Box 523, Douglas, Wyoming.

EQUIPMENT FOR SALE

FOR CABLE TOOLS
DEGEN PIPE AND SUPPLY CO.
Box 107, Red Fork Station, Tulsa, Oklahoma

FOR SALE, at Birch Run, Michigan. ±50 Oilwell geared power complete. 30 H.P. 2 cycle Type C Superior gas engine. ±50 Oilwell belt tightener complete with shaft, bearings, and clutch. Circulating tank 16' x 19' house. All in good condition. $2000 as it stands. Was used to pump twenty-five 1540' wells in field now abandoned. Smith Petroleum Company, 401 Keeler Building, Grand Rapids, Michigan.

PRICED TO SELL, QUICK DELIVERY

New and Used Welded Steel Tanks and Tool House. New and Used Bolted Steel Tanks and Separators. 6—10 ft. X 35 ft. Gasoline Tanks. 8—2,000 Gal. Gasoline Tanks, mounted on Semitrailers with Pumps, etc. 1—37,500 bbl. Tank, with Floating Roof. Write Independent Tank Co., Box 102, Phone 977, Seminole, Okla.

3—Type C-50 H. P. Superior Oil Eng. with 20" P.D., 7 Groove Pulleys & Idlers. 50 H.P. Fairbanks-Morse Type Y vertical oil Eng. flat 12" x 5' pulley. 165 H.P. Miller Twin gas eng. completely overhauled. All above in good operating condition. Brundred Oil Corporation, 208 Alameda Road, Kansas City 2, Mo.

ROTARY table, 4 shev. block, drill works, FWD motor, water pump, gas mud pump 4X7½X10 and motor, hose, mast 800' of 4" drill pipe, tool house, jin pole. Willard M. Glasco, 320 4th Nat'l. Bldg., Wichita, Kansas.

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We offer prompt shipment on skid-mounted hydrogen sulfide removal units for treating sour gas for pipe line or fuel gas purposes.

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1,441—5½" O.D., 8 R. T. Long N-80
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79—6⅝" O.D., 8 R.T. Long J-55
100—7" O.D., 8 R. T. Long J-55
144—7" O.D., 10-V Long J-55
15—8⅝" O.D., 8 R.T. Long J-55

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5—35,000 bbl. steel tanks, riveted, 5' x 10' steel sheets, 6 rings high, complete sheil, bottom, angles and ladder, cut down, rivets backed out, approximate weight 93 tons each. Price $3,500.00 each, gradesite, Stoy, Illinois.

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FOR SALE

Used Oil Field Gas Engines

* 3—Model 145 GKU Waukesha special oil field units with gas engine starters, gas, gasoline, and butane burning equipment, and otherwise standardly equipped, less power take-off, mounted on oil field type steel skids. Location Okla. City, Okla. Price, each $2,820.00
* 2—Model 6-PCS-1879 Buda standard oil field power units, with gas engine starters, gas, gasoline and butane burning equipment and otherwise standardly equipped, less power take-off, mounted on oil field type steel skids. Location Duncan, Okla. Price, each $6,624.00
* These engines are practically new and guaranteed accordingly.
* 1—R-225 Climax 8 cylinder engine complete with gas, gasoline and butan carburetors, and engine starter, mounted on oil field type steel skid. Location Duncan, Okla. Price "as is" $1,100.00

Address inquiries to Box D-108, The Oil and Gas Journal, Tulsa, Oklahoma.

120,000′—6⅝″ OD, 17.65#, seamless, range 3, beveled.
80,000′—4½″ OD, 8.65#, seamless, range 3, beveled.
2—complete pumping stations. All pipe & equipment practically new. Sell any quantity. Located Tulsa.

W. C. BERRY
P.O. Box 1858 Tulsa, Oklahoma Phone: 3-6141

SULLIVAN 22 Core Drill. Also truck mounted cable tool rig. Both only slightly used. Excellent condition throughout. R. B. McElwaine, Box 127, Little Rock, Ark.

STEEL PIPE FOR SALE

800 ft. 12″—250 ft. 8″—4000 ft. 6″—4000 ft. 4″—18,000 ft. 3″—3500 ft. 2½″. All above regular line pipe P/E. 10,000 ft. 2″—3000 ft. each of 1½″—1¼″—¾ etc., this T/C reg. line pipe, all black, like new. G. E. McHugh, 409 Bewley Bldg., Fort Worth, or Hotel Blazilmar, Taylor, Texas, or yard and office, Camp Swift, Texas.

HEAVY DUTY geophysical drill, 18′ kelly, chain pull down, hydraulic lift mast, 4½ x 6 G. D. pump, Twin Disc clutches. Mounted on 1943 Ford Truck. Waters Drilling Service, 69 Beacon Place, Pasadena 8, Calif.

Several Army Surplus 4½″ x 6″ Gasoline Duplex 1860 Pumps—two piece skid mounted with Chrysler 8 cylinder engines. Will sell pumps only or complete units about half price

H. H. COFFIELD
ATTN: W. H. Orr
Phones: 132—Rockdale, Texas
A-86084—Houston, Texas

COMBINED VAPOR SEPARATOR & FRACTIONATOR FOR THERMAL REFORMING

One (1) New 5′-6″ ID x 61′-0″ over-all height Bubble Tower made of 1¼″ Plate and lined throughout with 5/64″ and 7/64″ thick, 11-13% Chrome stainless steel, type 405. Stainless steel support plates in place for 15 Trays, (Trays not included). Constructed in accordance with the API-ASME Code, stress relieved and radiographed. Designed for 400 PSI @ 750° F. Fabricated by A. O. Smith Corporation. Platform and ladder clips installed.

WOOD RIVER OIL & REFINING CO., INC.
335 West Lewis Street, Wichita, Kansas
Telephone 7-3325

FOR SALE

CARDWELL MOBILHOIST complete with 5″ drilling tools, new 4000′ ¾″ drilling line (run about 100 hours), good 5000′ sand line, 4¾″ dart bailor and Midco Sand Pump, circle, circle jack, tool wrenches, and dog house. Unit is powered by 6MZ Waukesha which has recently been overhauled. Equipped with practically new 8⅝″ x 7″ (reinforced with 5½″) x 55′ single pole mast. Spudding chain and lines have only been run about 50 hours. Unit is in good operating condition.

Price is $7,000.00.

CARDWELL MODEL H SINGLE DRUM SERVICING UNIT, powered by SRK Waukesha and equipped with 8⅝″ x 7″ (reinforced by 5½″) x 55′ three sheave single pole mast. Also has spudding attachment which is not mounted. Unit has just been mounted on a 2½-ton Diamond T Truck that has been completely overhauled.

Price is $4,000.00.

CLARKE OIL WELL SERVICING COMPANY
520 South Turner Telephone 27
Hobbs, New Mexico.

FOR SALE: One National Shot Hole Drill, solid kelly, Gardner-Denver pump, now working in West Texas. Also 500 gal. Dodge water truck. Box C-968, The Oil and Gas Journal, Tulsa, Oklahoma.

CASING, RIGS, BELTS, TANKS, ENGINES: Everything for Cable Tool Drilling, Bought and sold. Tri-State Oil & Gas Company, Box 827, Phone 7-5121, Parkersburg, W. Va.

FOR SALE: 1 UMT Allis-Chalmers tractor on new rubber with Cooper Winch. Price $1,000.00. 1 Skid type Cooper Unit—Price $2,000.00. 1 Skid type Cardwell H Spudder with MZR Waukesha Motor. New string of five inch tools with quick change-over sockets. New 4,000 foot line. Price $5,000.00. Also have Cardwell Model QS Unit with telescope pole. Mounted on truck. Might sell. These Units are in good condition and suitable for wells up to 3,500 ft. Fred Frogge, Leon, Kansas. Phone No's 4316 or 2952.

FOR SALE

3½ miles, new 4½″ O.D. 11#, 1200# test API Continuous Weld Line Pipe, T & C, 78c per foot, f.o.b. cars Midcontinent area. Address inquiries to

Box D-120, The Oil and Gas Journal, Tulsa, Oklahoma

MANUFACTURERS LATEST DESIGN

Hydraulic Casing Pulling Units. Complete line of equipment. Units made to your specifications. Truck Mountings or Skid Units. Repair Service and Parts.

OKLAHOMA MACHINE & SUPPLY CO.
Ada, Oklahoma

NEW 6⅝″ O.D. API LINE PIPE

Seventy-three (73) Miles New 6⅝″ O.D. 13# API Electric Weld Line Pipe, Plain End, Beveled for Welding, Regular Mill Coating, double random length Van Dyke Protectors Applied. Rock Island Oil & Refining Co., Inc., 335 West Lewis Street, Wichita, Kans. Telephone 7-3325.

FOR SALE

12—230 H.P. Type 10 Bessemer New 17″ Power Cylinders complete ready to run with 16″ to 18″ Compressors. 1—230 H.P. Clark Horizontal with Compressors. Located Salem, Illinois.

ENGLE PETROLEUM, Incorporated
Box 655, Evansville, Indiana

NEW FRACTIONATING TOWER REFLUX DRUM

One (1) New fractionating tower, 5′-0″ I.D. X 89′-6″ over-all height X 1¼″ plate. Thirty-four (34) bubble trays, ten (10) 18″-300# manways. Stress relieved and built in accordance with API-ASME Code for 350 PSI working pressure.

One (1) new horizontal reflux drum, 5′-6″ I.D. x 18′-6″ over-all length x 1⅛″ plate. Stress relieved and built in accordance with API-ASME Code for 350 PSI working pressure.

ROCK ISLAND OIL & REFINING CO., INC.
335 West Lewis St. Wichita, Kansas
Phone 7-3325

FOR SALE: 4000′ 8⅝″ OD 36# Range 2 & 3, 8V Long T&C Grade "D" No. 1 Casing. 1775′ 5½″ OD 14# J-55 No. 1 Casing. LEVERING MACHINE WORKS, Oklahoma City, Phone 6-1366, Box 4002.

FOR SALE: 10,000 ft. 20″ OD x ¼″ Wall New Electric Weld Steel Pipe, Double Random Lengths; 50,000 ft. 18″ OD x ⅜″ Wall Used Steel Pipe, Single Random Lengths. Utility & Industrial Supply Company, 921 Michigan Ave., E., Jackson, Michigan.

FOR SALE: Wilson Giant draw works, powered by 2—J.L.-1335 Buda engines and Wilson chain compound. Like new condition, with bargain price. Terms. Melton Supply Co., Seminole, Okla.

FOR SALE: Two like new 74,000 bbl. cap. tanks. Low price, at Morgantown, W. Va. 2 new 10,000 bbl. bolted at N.Y. Darien Corp., 60 E. 42nd St., N. Y., N. Y.

FOR SALE: A-1 quality pipe; 30,000′ 5½″ O.D. 14#; 100,000′ 2″ line pipe; 25,000′ 2⅜″ 4½# upset tubing. Prices very reasonable. Write, wire, or phone The Interstate Pipe & Supply Company, Marietta, Ohio. Phone 2468.

FOR SALE: One of the Most Complete Rigs in Kansas. Wilson Giant Drawworks with G.M.C. Diesel Power. G.O.C. 225 Bethlehem Pump. Lee C. Moore Mast. Descriptive Inventory on Request. Shawver-Graham, Inc., 204 North Market, Wichita, Kansas.

FOR SALE: Sullivan 300A drilling rig complete ready to move to job, terms to reliable party. Phone 6508 or 3996, P.O. Box 501, Abilene, Texas.

Reconditioned Seamless Tubing

95,000 ft. 1½″ O.D.
120,000 ft. 2″ O.D.
55,000 ft. 2¼″ O.D.
75,000 ft. 3¼″ O.D.
80,000 ft. 4″ O.D.
21,000 ft. 5½″ O.D.

Single or Double Random lengths—
Plain Ends
Beveled for Welding

Sonken-Galamba Corp.
2nd and Riverview (X-497) Kansas City 18, Kansas
THatcher 9243

HELP WANTED

HOUSTON DISTRICT Sales Engineer: Engineer familiar with pumps, compressors, exchangers, etc., having sold this type of equipment in Texas for at least the last 3 years to refinery, gasoline plant, and pipe-line companies. Replies confidential. Box D-117, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Superintendent for combination natural gasoline and L.P.G. plant in Texas Gulf Coast area. Give record of past experience. Address Box C-990, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEERING

During the next several months we will increase our Engineering Organization engaged in the design of Oil Refinery Plants and Power Plants. Location Cleveland, Ohio. The men we need should be qualified as draftsmen, designers, checkers or in higher engineering skills on design of piping, instrumentation, pressure vessels, structural steel, concrete, mechanical or electrical. For presenting your qualifications and prompt consideration, write to us for application form.

ARTHUR G. McKEE & CO.
2300 Chester Ave., Cleveland 1, Ohio

HELP WANTED

NEW foreign and domestic Oil Employment Directory. Over 500 listings in drilling, production, refining, natural gasoline, pipelines, geological, exploration, supplies, manufacturers, services; and trucking, refinery and pipeline contractors, showing where to apply for jobs. Price $5.00. Oil Industry Mailing List, Box 2603, Tulsa, Okla. (Our 29th Year).

WANTED: Mechanical Engineer. Experienced in design of pumping units and well head equipment. Excellent opportunity for right man to become Chief Engineer for well established company. State age, qualifications, experience. Address: Box C-967, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Seismologists for division office of major oil company. Men with considerable experience as party chiefs preferred. These positions very attractive for men with families who want to settle in permanent locations. Give full details of education and experience in first letter. All replies will be held confidential. Reply Box D-113, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEERS, Executives, Technical Men. **Salaried positions—$3600 to $20,000. This confidential service for outstanding men who desire a change of connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details. Tomsett Associates, 1204 Berger Bldg., Pittsburgh 19, Pa.**

CONSTRUCTION MAN

For 2-year project, with civil engineering and pipe line building experience, top references. Address Box C-981, The Oil and Gas Journal, Tulsa, Oklahoma.

An old established supply distributor requires the services of a high grade pumping equipment sales engineer, age 35-45. Must have good Mid-Continent area contacts. Excellent opportunity for one who can produce. Give full particulars which will be kept strictly confidential. Box D-105, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED
MIDDLE EAST
REPRESENTATIVE

An experienced oil-country representative to handle established Packing and Gasket line on commission basis in Middle East area. Well established company desires aggressive representation in Saudi Arabia, Iran, Iraq, Kuwait, etc.

BOX D-101

THE OIL AND GAS JOURNAL

TULSA, OKLAHOMA

SITUATIONS WANTED

LANDMAN: many years major company experience; geological background; desire connection; company or independent operator. Box D-109, The Oil and Gas Journal, Tulsa, Oklahoma.

OFFICE and warehouse clerk with executive ability, three years in Venezuela, good references, wide oil experience, will accept foreign employment, available in three weeks: Post Office Box 264, Hamilton, Ontario.

MINING Engineer, production and management experience, presently employed as Petroleum Engineer, desires position Latin America. Excellent knowledge of Spanish. Age 33. References. Box D-119, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICIST: Young married man, five years experience, four years in Venezuela as computor, party chief, and central office interpreter; thoroughly experienced in both interpretation and crew management, desires position preferably with permanent location, either in U. S. or foreign. Opportunity to assume responsibility and to advance in position more important than salary. Write Box C-998, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

ENGINEER-SUPERINTENDENT — M.S. in Ch.E., age 35, registered Texas engineer, thorough knowledge refining, nine years varied experience engineering and plant supervision, most recently manager small refinery, available at once due to plant shut down. Write WRS, Box 112, Winnsboro, Texas.

EXECUTIVE with thorough knowledge of refinery operations and materials desires to represent manufacturer of nationally advertised products. Box D-115, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM Engineer—23 years experience in drilling and production. Past ten years general production engineering. Supervisory experience in drilling, completion and production practices. Desire connection with active independent or would consider connection in sales engineering. Box D-114, The Oil and Gas Journal, Tulsa, Okla.

INDEPENDENT Petroleum Geologist with up-to-date Oklahoma Regional subsurface maps, records, and years of experience with major oil companies, desires combination office and field geological work from Tulsa headquarters. P. O. Box 1884, Tulsa, Oklahoma.

SALES ENGINEER, Houston resident, well acquainted and presently contacting Chemical, Refining, Allied Industries. Available short notice. Box D-111, The Oil and Gas Journal, Tulsa, Oklahoma.

MANAGEMENT of small substantial oil company operating in Texas wanted by operator of wide experience and with ample reference as to ability and responsibility. Prefer proposition with participation in results produced. Box D-107, The Oil and Gas Journal, Tulsa, Okla.

PETROLEUM ENGINEER: B. S. Six years excellent drilling and production experience; wants supervisory position with aggressive Gulf Coast Independent. Box D-116, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST: Six years experience with major company in Illinois Basin. Desires position with progressive independent operator. Excellent references and available immediately. Box D-118, The Oil and Gas Journal, Tulsa, Oklahoma.

PURCHASING AGENT

A top executive is available who has been successful in handling the administrative and functional work of a purchasing department. This man knows how to get profit from inventory and how to set up a comprehensive materials program. His purchasing experience includes machinery, electrical equipment, tanks, pipe lines, valves, gas engines, tools, chemicals, steel, wood and paper products. He knows shop and manufacturing practices. Nine of his twelve years' work in purchasing have been with one company. He is 42 and is a Mechanical Engineer. For complete information about this man, write to Chas. J. Loveless Personnel Service, 508 Mayo Building, Tulsa, Oklahoma.

REFINERY OPERATING EXECUTIVE SEEKS CHALLENGING JOB

The writer has a responsible refinery job now but wants a better one which will demand full exercise of everything he learned in school and in 13 years experience in refineries in many parts of the country, directing the production of gasoline and its components under war time and peace time conditions.

I am a chemical engineer, 36, thoroughly acquainted with refinery operations and techniques, especially familiar with all processes for making and treating motor fuel—including both Fluid and Thermofor Catalytic Cracking. Men like me and work for me—and I like them.

Married and have two children. We'll go anywhere opportunity calls. Box D-121, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE

88,000 ACRES Southern Tennessee Timber—Mineral land. No reservations $3.50 acre. Details, Earl Jester, 12744 Vanowen, North Hollywood, California.

MERCURY

Pure grade, 0000% non volatile residues. Each lot tested for purity before packaging. Packed in 1, 5 & 10 lb. glass containers. For prices & terms address H M Co., P. O. Box 6012, Dept. O, Kansas City, Mo.

ROYALTIES

DEEDED ROYALTIES

San Juan Basin & Permian Basin. Write Harry S. Wright, Wright Bldg., Farmington, New Mexico.

ROYALTIES IN HOT AREAS!

Recent strikes have focused attention on Montana's deeper oil zones and major companies are moving fast, drilling and leasing. We buy direct in the field, sell direct to our customers. Write LANDOWNERS ROYALTIES COMPANY, Box 1225, Great Falls, Montana.

CASH MARKET for PRODUCING ROYALTIES

ROBERT L. KINKAID
World Bldg. Tulsa, Oklahoma

WE will buy producing or non-producing oil royalties. Standard Security Company, 115 Broadway, New York 6.

LEASE AND DRILLING BLOCKS

OIL and Gas lease; 60 acres lots 2 & 3, 17-35 17 E. Montgomery Co., Kans. Wilcox 1200's One well part time pumping making approximately 5 bbls. Full time pumping should make 8 to 12. 2 ideal locations should bring production to 50 bbls. Price $3500. M. J. Regan, Coffeyville, Kans.

FOR SALE: Oil and Gas Leases and drilling propositions in shallow territory of Allen, Simpson, and Warren Counties, Kentucky. W. P. Harley, Bowling Green, Ky.

OIL and wet gas expansion and development practically unlimited in most all East Texas. Let us help with one, checkered, or a block of leases, also mineral rights and land. We have had 30 years' constant contact in this area, and know of many favorable localities. Box C-987, The Oil and Gas Journal, Tulsa, Oklahoma.

HAVE three small leases in sight of new oil strike at Seventy-Six, Clinton County, Kentucky, of 200 bbl. daily. Will take royalty override only, if taken quick. John A. Damron, Albany, Kentucky.

WILL BUY oil leases anywhere, large or small blocks if any likelihood of oil field or good geology, provided you co-operate in furnishing all necessary information. Write fully what you have. Box 2153, Denver, Colo.

LEASES ROYALTIES

PRODUCING OR NONPRODUCING

Texas, New Mexico, Oklahoma, Louisiana and Illinois

Inquiries Invited

B. D. BUCKLEY

60 Broadview Drive, Clayton (5), St. Louis, Missouri

ATTENTION
OIL AND GAS OPERATORS

We own and control large block leases in Southwestern Wyoming recommended by two eminent petroleum engineers to be the greatest potential gas and oil fields in Rocky Mountain area. We offset sand production having produced to date over 12,000 bbls. per acre at about 1,200 feet. Gas wells have been drilled on and adjacent to our property with estimated capacities as high as 100 million feet per day at shallow depths. Accurate and current geology available including seismograph, core drilling, electric log data. Oil pipe line facilities present and excellent market for gas now a reality. Prolific deeper pays reported assured. Put your idle rigs to work or join us in developing this great field. Immediate action imperative for liberal deals.

Box D-102, The Oil and Gas Journal, Tulsa, Oklahoma

WANTED

WANTED: OPERATOR to drill and finance well to depth of 4500 ft. in Williamson County, Texas. 8000 acres in one block. Tested with Magno-Electrograph. Correspond with Ed Ilse, Route 2, Georgetown, Tex.

PATENT ATTORNEYS

PATENT Practice before U. S. Patent Office. Validity and Infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request. Lancaster, Allwine & Rommell, Registered Patent Attorneys, Suite 418, 815-15th Street, N.W., Washington 5, D. C.

LEGAL BLANKS

BURKHART LEGAL BLANKS since 1906 Oil-Gas (all states), Business, Real Estate, Legal Forms, Leases, Revised With Government Regulations, Commercial Printing, Catalog and Samples on request. Burkhart Printing & Stationery Company, 118 South Cincinnati, Tulsa 3, Oklahoma.

MANUFACTURERS REPRESENTATIVE

WELL KNOWN and permanently established Manufacturers representative now selling Producers, Drilling Contractors and Supply Companies desires one additional manufacturers account on straight commission basis. Two men now working Oklahoma and Kansas and can furnish capable representative for other fields. Box D-106, The Oil and Gas Journal, Tulsa, Oklahoma.

BIR Clarifies Rules For Employes' Trusts

WASHINGTON.—Oral agreements establishing employes' trusts will not be sufficient to make employers' contributions deductible from income, collectors of internal revenue have been advised by the Bureau of Internal Revenue.

In a letter of instructions to collectors, the bureau pointed out that in many jurisdictions an oral agreement may be a sufficient basis for the establishment of a valid trust, but is not considered adequate to insure the impossibility of diverting trust funds.

Section 165 of the Internal Revenue Code, providing for the setting up of employes' trusts, stipulates they shall be exempt only if it is impossible under the trust instrument to divert any part of the corpus or income to purposes other than for the exclusive benefit of the employes or their beneficiaries.

To meet this and other conditions laid down in the code, it was ruled, there must be a valid trust recognized as such under the law prevailing in the jurisdiction to which the trust is subject; the trust must be evidenced by an executed "instrument," and the instrument must definitely and affirmatively preclude the prohibited diversion.

The term "trust instrument," the bureau said, means a document or documents clearly setting forth the terms of the trust. "While the 'instrument' must be in writing containing sufficient words to make the prohibited diversion impossible, and be signed by persons competent to bind the parties before the close of the taxable year under consideration, it is not required to be in a specified form but must be in such form that the provisions of the trust agreement could be enforced on the basis of such written evidence alone," it was explained.

Corporation Joint Tax Rules Eased by Bureau

WASHINGTON. — The Bureau of Internal Revenue announced last week that affiliated corporations which filed consolidated federal income-tax returns for fiscal years ended in 1948 may elect to file separate returns for fiscal years ending in 1949 if they find such action advantageous.

The bureau decision was based on a provision of the Internal Revenue Code that if a consolidated return is made for any taxable year a similar return must be filed for each subsequent taxable year during which the affiliated group remains in existence unless the tax law is amended in such a way as to make the filing of consolidated returns less advantageous to affiliated groups as a class.

"It is held that the law applicable to the filing of consolidated federal income-tax returns has been so amended as to make less advantageous to affiliated groups as a class the continued filing of such returns," the bureau ruled.

CALENDAR OF EVENTS

August

United Nations Scientific Conference on the Conservation and Utilization of Resources, U. N. Interim Headquarters, Lake Success, N. Y., August 17-September 6.

September

Interstate Oil Compact Commission, summer quarterly meeting, Stanley Hotel, Estes Park, Colo., September 1-3.

Pacific Coast Gas Association, fifty-sixth annual convention, Santa Barbara, Calif., September 7-9.

Instrument Society of America, annual meeting and exhibit, Municipal Auditorium, St. Louis, September 12-16.

National Petroleum Association, Hotel Traymore, Atlantic City, N. J., September 14-16.

American Gas Association, annual convention, Chicago, September 17-20.

American Chemical Society, 116th national meeting, Atlantic City, N. J., September 18-23.

American Institute of Chemical Engineers, Mt. Royal Hotel, Montreal, September 18-20.

American Association of Oilwell Drilling Contractors, ninth annual meeting, Baker Hotel, Dallas, September 19-21.

National Butane-Propane Association, Jefferson Hotel, St. Louis, September 19-21.

Mid-Continent Oil and Gas Association, twenty-seventh annual convention, Louisiana-Arkansas division Roosevelt Hotel, New Orleans, September 22-23.

American Institute of Mining and Metallurgical Engineers, regional meeting, Nell House, Columbus, Ohio, September 25-28.

American Society of Mechanical Engineers, fall meeting, Erie, Pa., September 28-30.

October

Independent Petroleum Association of America, Blackstone Hotel, Fort Worth, Tex., October 2-4.

American Society of Mechanical Engineers, petroleum division, 1949 Petroleum Mechanical Engineering Conference, Biltmore Hotel, Oklahoma City, October 2-5.

National Association of Corrosion Engineers, South-Central Regional Division, annual meeting, Adolphus Hotel, Dallas, October 3-4.

National Lubrication Grease Institute, Hotel Roosevelt, New Orleans, La., October 3-5.

American Institute of Mining & Metallurgical Engineers, Petroleum Branch, fall meeting, Plaza Hotel, San Antonio, October 5-7.

American Society for Testing Materials, first Pacific area national meeting, Hotel Fairmont, San Francisco, October 10.

Texas Mid-Continent Oil and Gas Association, annual meeting, Rice Hotel, Houston, October 13-14.

California Natural Gasoline Association, Ambassador Hotel, Los Angeles, October 7

Oil Progress Week, October 16-22.

American Gas Association, annual convention, Chicago, October 17-20.

American Institute of Mining & Metallurgical Engineers, Petroleum Branch, fall meeting, Elk's Club, Los Angeles, October 20-21.

Independent Natural Gas Association of America, annual meeting, Baker Hotel, Dallas, October 31.

November

Society of Automotive Engineers, diesel, Chase Hotel, St. Louis, November 1-2.

Society of Automotive Engineers, fuels and lubricants, Chase Hotel, St. Louis, November 3-4.

American Petroleum Institute, annual meeting, Stevens Hotel, Chicago, November 7-10.

Petroleum Electric Power Association, annual conference, Hotel Beaumont, Beaumont, Tex., November 17-18.

American Society of Mechanical Engineers, annual meeting, Hotel Statler, New York, November 27-December 2.

December

American Institute of Chemical Engineers, annual meeting, William Penn Hotel, Pittsburgh, Pa., December 4-7.

NOMADS

Houston Nomads, second Monday of each month, Ye Ole College Inn, Houston.

Los Angeles Nomads, second Wednesday each month, Jonathan Club.

LEGAL

ADDITIONAL TRIBAL INDIAN LANDS BEING ADVERTISED: Notice has been posted that 14,572.97 acres of additional Tribal Indian lands have been offered for sale, bids on which will be opened August 9, 1949, at 2:00 P.M., at the Uintah & Ouray Agency office, Fort Duchesne, Utah. The acreage being offered is located in Township 4 South, Ranges 4, 5, 6 and 7 West, USBM, State of Utah. Full particulars, with exact description of acreage may be obtained from the Uintah and Ouray Agency, Fort Duchesne, Utah, or the U. S. Geological Survey, Casper, Wyoming.

LEGAL

16,808.82 acres of Tribal Indian lands located in Township 1, North, Range 2, West; 1 North, 3 West; 1 South, 2 West; 1 South, 3 West; 1 South, 1 West; 1 South, 2 West; in the Uintah and Ouray Reservation Utah, are being advertised for lease, bids on which will be opened August 4, 1949, at 2:00 P.M., at the office of Forrest R. Stone, Superintendent of the Uintah and Ouray Indian Agency, Fort Duchesne, Utah. Full descriptions, and copies of advertisement may be obtained from Superintendent Stone or from Supervisor J. R. Schwabrow, U. S. Geological Survey, Federal Building, Casper, Wyo.

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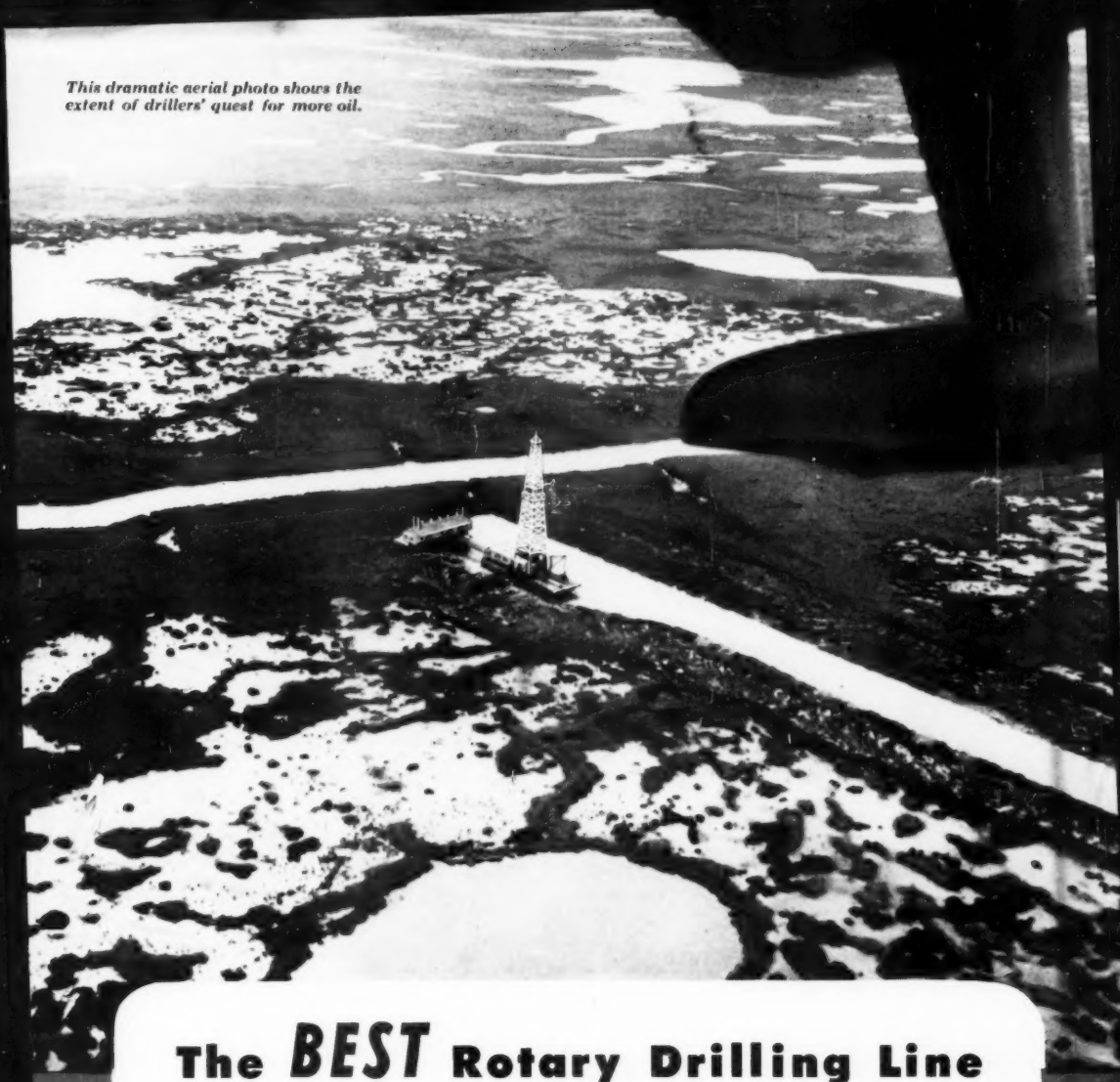

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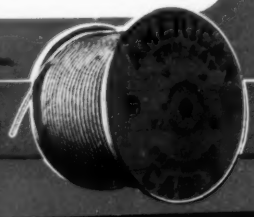

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